APPLICATION OF EFFECTIVE MICROORGANISMS FOR *DENDROBIUM* SP. CULTIVATION: CASE STUDY ON SAMPRAN DISTRICT, NAKHONPATHOM PROVINCE

SASIWAN DHUNMIGABOVORN

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ABSTRACT

This research was focused on the processes of orchid cultivation in Sampran District, Nakhonpathom Province, Thailand, and the efficiency of Effective Microorganisms (EM) to enhance the quantity and quality of orchid production and disease protection. Information on orchid cultivation by 72 agriculturists who live in Sampran District was surveyed by individual interview. In addition, characteristics and efficiency of 3 formulas of EM including agriculturist formula (A), government formula (B) and commercial formula (C) and their efficiency were investigated. The results showed that EM was rarely used in orchid cultivation because EM caused rapidly deterioration of plantation materials. Presently, inorganic fertilizers are mostly used in many orchid farms. The highest numbers of bacteria ($5x10^5$ CFU/ml) and fungi ($3x10^5$ CFU/ml) were found in EM formula C. However, EM formula A contained the highest number of actinomycetes ($1.8x10^3$ CFU/ml). In the greenhouse investigation, the result showed that treatment 5 (apply only EM formula C) and 8 (apply both EM formula C and chemical fertilizer) were more effective to enhance both quantity and quality of orchid production, but not the number of orchid bunches, than other treatments. Moreover, EM formula C plays a potential role in disease protection in orchids. Surprisingly, the use of chemical fertilizer could induce lesion development in orchids. It could be concluded that the efficiency in orchid cultivation of each EM formula depends on the quantity and types of microorganisms. Thus, the use of selected EM formula could enhance the efficiency in orchid cultivation better than chemical fertilizer usage. A guideline for orchid cultivation by using EM and reducing chemical fertilizer application should be provided for agriculturists.

KEY WORDS: EFFECTIVE MICROORGANISMS / *DENDROBIUM* / ORCHID / CULTIVATION / NAKHONPATHOM

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การประยุกต์ใช้จุลินทรีย์ที่มีประสิทธิภาพในการปลูกเลี้ยงกล้วยไม้สกุลหวาย กรณีศึกษาอำเภอสามพราน จังหวัดนครปฐม (APPLICATION OF EFFECTIVE MICROORGANISMS FOR *DENDROBIUM* SP. CULTIVATION: CASE STUDY ON SAMPRAN DISTRICT, NAKHONPATHOM PROVINCE)

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วท.ม.(การวางแผนสิ่งแวดล้อมเพื่อพัฒนาชุมชนและชนบท)

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บทคัดย่อ

การวิจัยครั้งนี้มุ่งเน้นการศึกษากระบวนการปลูกเลี้ยงกล้วยไม้บริเวณอำเภอสามพราน จังหวัดนครปฐม และการศึกษาประสิทธิภาพของจุลินทรีย์ที่มีประสิทธิภาพ (EM) ในการส่งเสริมการผลิตกล้วยไม้ทั้งเชิงคุณภาพและปริมาณ รวมทั้งการป้องกันโรคในกล้วยไม้ โดยการทำการสัมภาษณ์ข้อมูลการปลูกเลี้ยงกล้วยไม้จากเกษตรกร 72 คนที่อาศัยในอำเภอสามพราน ตลอดจนทำการศึกษาคุณสมบัติของ EM และประสิทธิภาพของ EM ทั้ง 3 สูตร อันได้แก่ สูตรจากพื้นที่ศึกษา (A), สูตรจากหน่วยงานราชการ (B) และสูตรการค้า (C) ผลการทดลองพบว่า เกษตรกรมีการใช้ EM ในการปลูกเลี้ยงกล้วยไม้น้อย เนื่องจากมีการเตรียมและวิธีการใช้ที่ยุ่งยาก รวมทั้งทำให้วัสดุปลูกผุพังเร็วขึ้น ดังนั้น ในปัจจุบันเกษตรกรจึงนิยมใช้ปุ๋ยเคมีเป็นส่วนใหญ่ สำหรับปริมาณจุลินทรีย์ใน EM ทั้ง 3 สูตร พบว่า EM สูตร C มีปริมาณแบคทีเรีย ($5x10^5$ CFU/ml) และฟังไจ ($3x10^5$ CFU/ml) สูงสุด ในขณะที่ EM สูตร A มีปริมาณแอคติโนมัยซีท ($1.8x10^3$ CFU/ml) สูงสุด ส่วนการศึกษาในเรือนทดลอง พบว่า ตำรับที่มีการใช้ EM สูตร C (ตำรับที่ 5) และตำรับที่มีการใช้ EM สูตร C ร่วมกับปุ๋ยเคมี (ตำรับที่ 8) มีประสิทธิภาพในการส่งเสริมปริมาณและคุณภาพผลผลิตกล้วยไม้ดีกว่าตำรับอื่น ๆ ยกเว้น จำนวนช่อดอกมีปริมาณน้อยกว่าชุดควบคุม นอกจากนี้ตำรับที่มีการใช้ EM สูตร C ยังช่วยในการป้องกันการเกิดรอยโรคในกล้วยไม้ได้ดี ในขณะที่ตำรับที่มีการใช้ปุ๋ยเคมีมีการชักนำให้เกิดรอยโรคบนกล้วยไม้มากขึ้น จากการวิจัยนี้สรุปได้ว่า ประสิทธิภาพของ EM แต่ละสูตรในการส่งเสริมคุณภาพและผลผลิตกล้วยไม้ขึ้นกับจำนวนและชนิดของจุลินทรีย์ที่เป็นองค์ประกอบใน EM ดังนั้น การใช้ EM บางสูตรจึงสามารถส่งเสริมประสิทธิภาพในการปลูกเลี้ยงกล้วยไม้ได้ดีกว่าการใช้ปุ๋ยเคมี ซึ่งนำไปสู่การนำเสนอแนวทางการปลูกเลี้ยงกล้วยไม้โดยใช้ EM และลดการใช้สารเคมีแก่เกษตรกรต่อไป

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LIST OF ABBREVIATIONS

B.E.	Buddhist era
°C	Degree celcius
m	Meter
cm	Centimeter
km	Kilometer
nm	Nanometer
mm	Millimeter
ha	Hectare
g	Gram
kg	Kilogram
L	Liter
CFU	Colony forming unit

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CHAPTER I
INTRODUCTION

1.1 Background and justifications

Thai orchid flower is one of the most important agricultural products of Thailand because the income values from its exportation is essentially to elevate Thai economic. The Thai orchid exportation data B.E.2542-2547 from Plant Guarantee Export Service of Agricultural Regulation Division, Ministry of Agriculture and Cooperatives, illustrated Japan, Italy and the United States of America had been the three important markets. The additive income values from the Thai orchid exportation from B.E.2542-2547 was more than 9,320.57 million baths and its tendency was growth continuously (1).

According to the income values from Thai orchid exportation, then Ministry of Agriculture and Cooperatives (Thailand) is set to be one of the best four agricultural product champions of Thailand. However, the exportation of Thai orchid still has vital problems that impacted on both quality and quantity of Thai orchid and leading to profit loss. These are the several plant pests; for example, thrips, orchid gall midge and a many of plant pathogens including bacteria, fungi, viruses.

Nowadays, Department of Agricultural Extension was considered to these problems, then supported the improvement the orchid industry in order to increased both quantity and quality of the product to meet the world standard. In addition, the standard for Thai orchid was launched by Ministry of Agriculture and Cooperatives in B.E.2541 (2) (Appendix A). The application of chemical fertilizer and pesticides are most expanding method, because it provides the best result in a short period of time and convenience to use. Moreover, the usage of these chemical substances in the traditional orchid farming system had caused many undesirable effects including high cost of chemical substances, the soil pollution, the adverse effects on human health and living organisms in the ecosystem.

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Due to these problems, many researchers have been tried to apply the concept of organic farming and biotechnology which are utilized the activity of microorganisms to replace chemical pesticides. Organic farming is usually use any biomaterial that possess the following three criteria namely high specificity against the targeted plant pathogens, easy degradability after effective usage, and low cost for mass production. The ubiquitous microorganisms and their biosynthetic capabilities, given a specific set of environment and cultural conditions, has made them likely candidates for solving particularly difficult problems in the life sciences and other fields as well. The various ways in which microorganisms have been used over the past 50 years to advance medical technology, human and animal health, food processing, food safety and quality, genetic engineering, environmental protection and agricultural biotechnology. In addition, the effective treatment of agricultural and municipal wastes that provided a most impressive record of achievement though many of these technological advances would not have been possible using straightforward chemical and physical engineering methods.

Effective Microorganisms (EM) is a group of microorganisms. It consists of many types of microorganisms (fungi, bacteria, actinomycete) that use for agricultural application. Many advantages of EM had admitted and well known in worldwide on the reducing impact side from the chemical technology and environmental friendly. In Thailand, Division of Medical Science (Ministry of Public Health) had analyzed components of EM and insured the advantages of EM on agriculture, livestock, aquaculture including environment (3).

Thus, this research was emphasized on the usage of EM to improve both the quality and quantity of *Dendrobium* sp. production and the plant diseases protection. The selected site of this study was the expanding of orchid agro-industry area in Sampran District, Nakhonpathom Province. This result was expected to be provide a proper guideline for Thai orchid cultivation by using biotechnology application.

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1.2 Objectives

1.2.1 To survey the orchid production technology at Sampran District, Nakhonpathom Province.

1.2.2 To investigate the efficiency of EM on the enhancement of quantity and quality of orchid production and plant disease protection.

1.2.3 To compare the present orchid production technology (chemical application) and the biotechnology application (EM application) for orchid cultivation.

1.2.4 To develop a guideline for *Dendrobium* sp. cultivation by using biotechnology application.

1.3 Conceptual framework

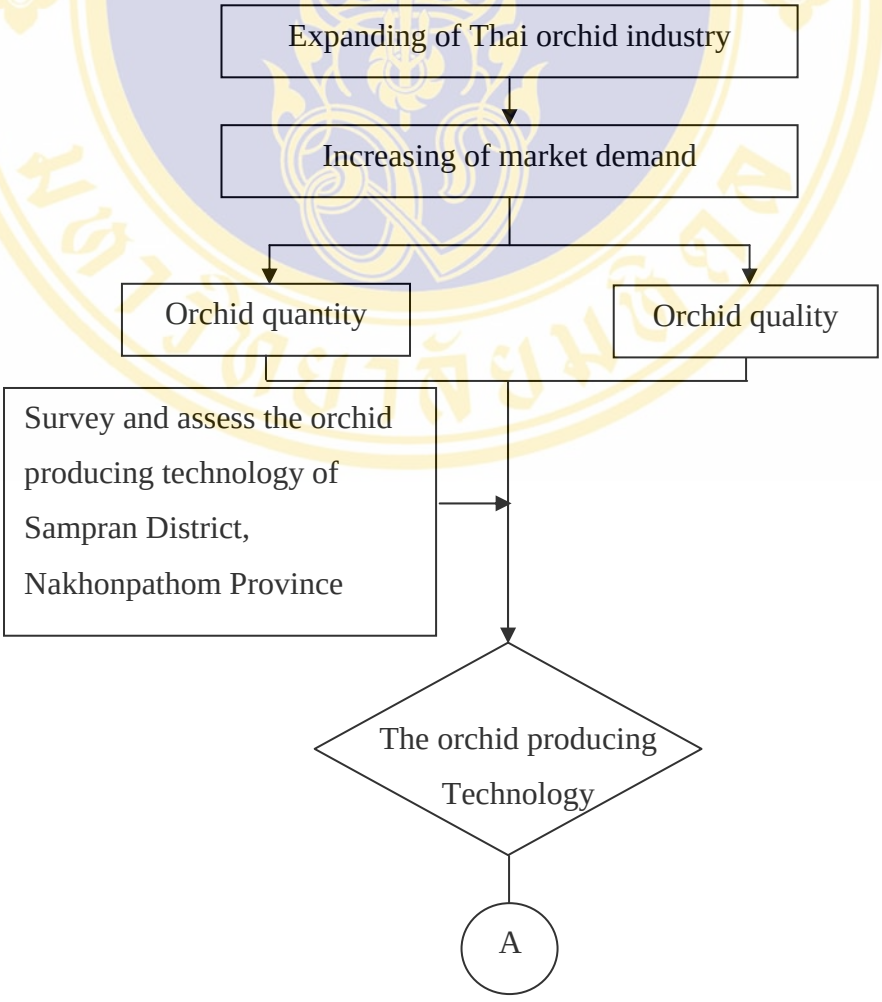

Figure 1-1 Conceptual framework

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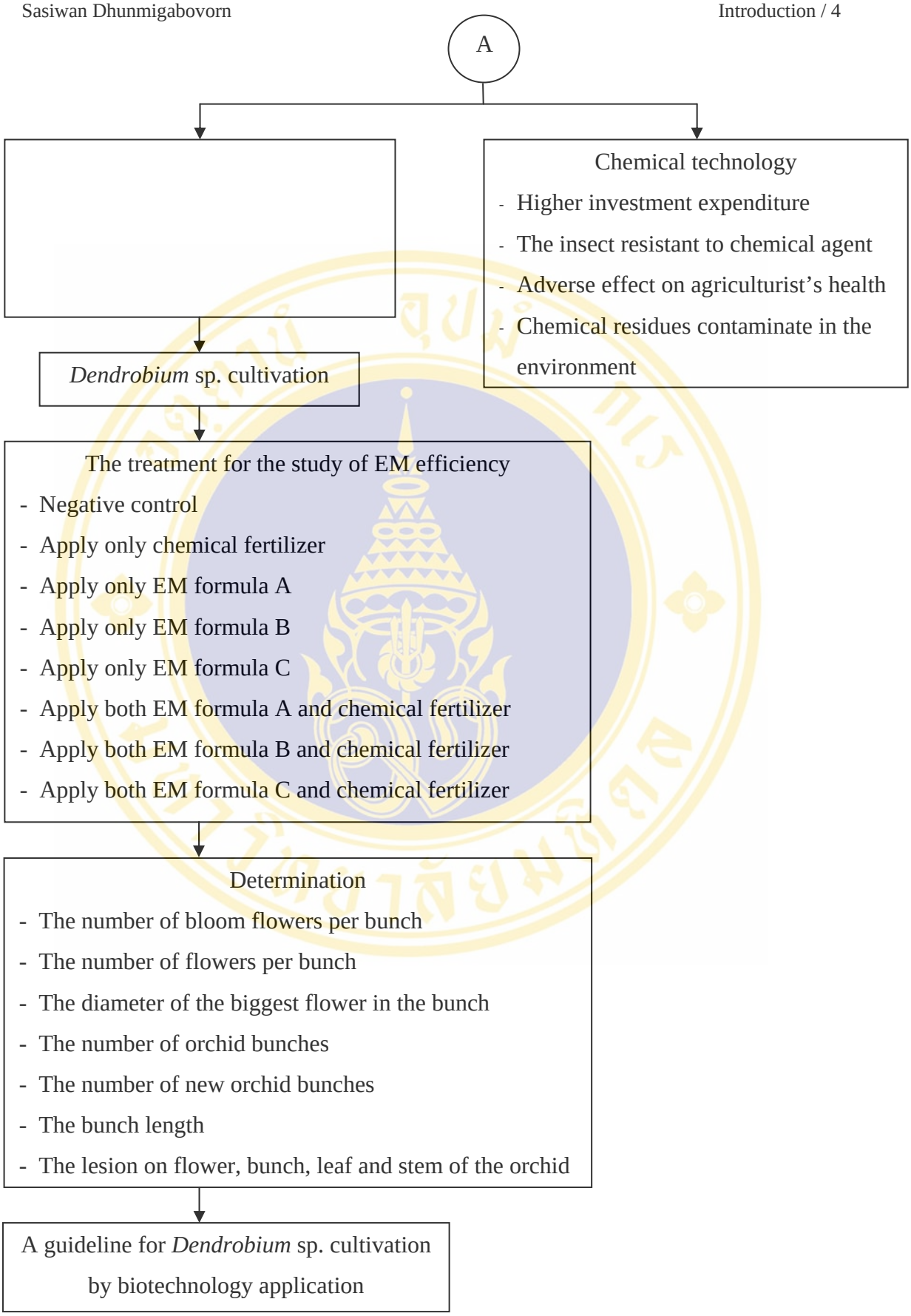

Figure 1-1 Conceptual framework (Cont.)

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1.4 Definition of terms

1.4.1 Cut-flower orchid refers to hybrid orchid providing fruitful flower for cutting to sale.

1.4.2 Cultivation technology refers to the method and procedure for orchid cultivation including: increase productivity, quality improvement and plant disease protection.

1.4.3 Quality of orchid refers following the standard of Department of Agriculture, Ministry of Agriculture and Cooperatives, Thailand.

1.4.4 Agriculturist refers to the leader or representative of the family who work in orchid farm.

1.5 Research hypothesis

1.5.1 Orchid production technology in the study area is normally using chemical fertilizer.

1.5.2 Biotechnology is an effective technology to increase productivity, quality improvement and disease protection in the orchid cultivation.

1.6 Expected outputs

1.6.1 To gain the information of orchid producing technology and their problems in the study area.

1.6.2 To understand the efficiency of EM for increasing quantity and quality of orchid production and plant disease protection in the orchid cultivation.

1.6.3 To propose a guideline for orchid cultivation by using biotechnology application.

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1.7 Anticipated benefits

1.7.1 A guideline for *Dendrobium* sp. cultivation should be applied to that use in other orchid agricultural areas by some promotion mechanisms via Agricultural Promoting Authority, Ministry of Agriculture and Cooperatives.

1.7.2 The use of biotechnology for orchid cultivation results in the reduction of the chemical usage as well as prevention of the environmental pollution.

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CHAPTER II
LITERATURE REVIEW

The study on the application of effective microorganisms for *Dendrobium* sp. cultivation: case study on Sampran District, Nakhonpathom Province was reviewed on concept, theory and related researches in the following topics:

1) The characteristics of orchid family
2) The growth of orchids
3) *Dendrobium* sp.
4) Orchid plantation
5) Situation of orchid production and orchid export market in Thailand
6) Diseases of orchids
7) Biotechnology
8) Effective microorganisms, EM
9) General information in economic and social at Nakhonpathom Province
10) Related researches

2.1 The characteristics of orchid family

The Orchidaceae is one of the largest families of monocotyledonous plants. This family is in subdivision Angiospermata, division Spermatophyta, comprising over 25,000 species (4) with new species found and described every year. As a result of the wide distribution, the species vary greatly. They may be terrestrial (growing on the ground, as opposed to water), epiphytic (growing above the ground, supported nonparasitically by another host plant and deriving nutrients and water from the surrounding air), lithophytic (growing on the surface of rocks), or even subterranean (growing beneath the surface of the growing medium) (5). Presently, many scientific

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researches have been successfully improved on the reproduction, planting and cultivation of orchids.

According to Dressler (4), the major distinguishing features of the orchid family are as follows:

2.1.1 The stamens are all on one side of the flower, rather than being symmetrically arranged. Most orchids have only one fertile stamen except for one genus which has three fertile stamens.

2.1.2 The stamen and the pistil are at least partly or completely united. In most of orchids, they are completely united so we call this single structure “the column” (Fig. 2-1).

2.1.3 Their seeds are tiny and numerous. Some of the orchids have much larger and more complex seeds than others but are characterized as tiny and numerous when compared with most other plants.

2.1.4 The flower usually has a lip or labellum. This is really the petal (or inner perianth segment) that is opposite to the fertile stamen. However, in some orchids the lips are not very different from the other two petals (Fig. 2-1).

2.1.5 The flower usually twists around in the course of development. This process is known as resupination. In the orchid bud, the fertile stamen develops on the side away from the stem and the lip develops on the side next to the stem. If the bud merely bends away from the stem, the lip would be upper most and the fertile stamen would be on the under side of the flower. But most orchid buds twist around during their development, so the lip is on the lower side of the flower when it opens.

2.1.6 A part of the stigma (the rostellum) is usually involved in transferring of the pollen that is the one of major subject of orchid evolution.

2.1.7 The pollen is usually bound together into a few large masses (pollinia). This characteristic along with the rostellum is intimately involved in pollination by insects and birds.

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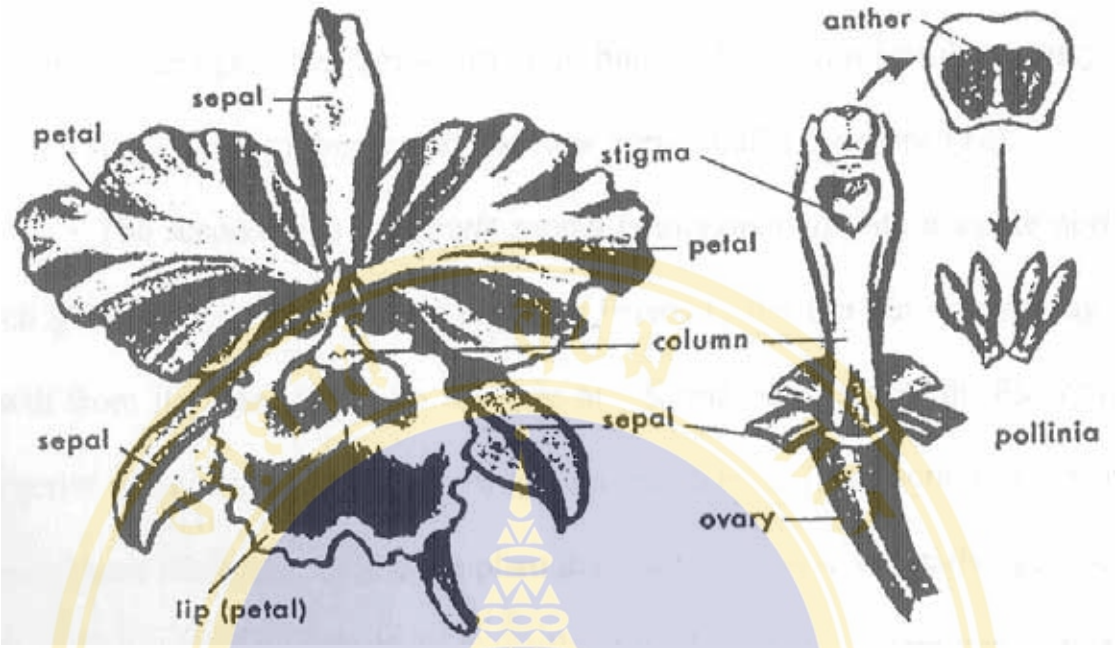

Figure 2-1 Conformation of a typical orchid flower (6)

2.2 The growth of orchids

In general, there are two basic patterns of growth among orchids, which are sympodial and monopodial. First, sympodial which makes a new growth each year from the base of the preceding growth and this new growth produces flowers, makes its own set of roots and gives rise to another new growth the following season. Such a plant consists of several stems arising from a creeping ground stem, or “rhizome”. Many orchids are of this type such as cattleya, oncidiums, epidendrums and odontoglossums, which have heavy, thickened stems and thick hard leaves. The thickened stems of sympodial orchids are called “pseudobulbs”. Each pseudobulb with the portion of rhizome at its base is essentially a plant in itself. Pseudobulbs divided singly from each other will give rise to new plants. Therefore, divisions are usually made of clumps of at least three preferably four pseudobulbs. There is a bud at each joint of the rhizome, but not all of the buds become active and develop into new growths. Sometimes two buds will develop simultaneously from the base of a single lead, giving rise to two new pseudobulbs from one (7).

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The second type of growth model is monopodial with a single upright stem which grows taller each year, adding new leaves to the top but not making any new growth from its base. It has no rhizome and forms no psedobulb. Flowering stems and aerial roots come from between the leaves following each other in succession up the stem year after year. While the plant does not form new vegetative growth from its base, it may branch from buds in the axils of the leaves. For examples, vandal, phalaenopsis and aerides have a single main stem and grows quite tall, adding several new leaves to its tip every year. The leaves grow close together alternating on the right and left sides and the flower stems also alternate sides, coming from the axils of leaves on the upper part of the plant (5).

2.3 *Dendrobium* sp.

Dendrobium is the largest among all orchid genera with more than 1,500 species widely distributed throughout the world. Many are from India, Myanmar, Sri Lanka, China, Japan, Australia and Thailand (8). The genus *Dendrobium* promises variety both size and character of the plants and of the flowers and the manner in which they are produced. Some of them give erect or arching sprays of five to twenty flowers, some give drooping sprays of a dozen to a hundred blooms and still others in which almost the entire length of the pseudobulb bears clusters of flowers at each node. Many have quite unique and appealing characteristics. The individual flowers are often small but all are perky or dainty, often of a glistening crystalline texture of velvety softness. The colors are rich ranging from rose and violet tones, occasionally almost to red, to the most brilliant of yellow and gold. Some species are white (7).

All of *Dendrobium* are epiphytic and all make new growths each year from a rhizome. The growth come close together so that a plant with many stems springs from a rather small basal area. The flowers are characterized by mentum formed by the joining of the lateral sepals to the foot of the column. In some the base of the fused sepals forms a short spur covering the mentum. The dorsal sepal and the petals are free. The lip narrows at its base to a stalk that is attached to the base of the column foot.

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The side lobes of the lip usually enfold the short column while the outer lobe is spreading, pointed or rounded, sometimes fringed (7).

Dendrobium is an interesting orchid which is a commercial cut-flower orchid cultivar in Thailand because of its beautiful shape and white color.

2.4 Orchid plantation

The basic requirement of plants are warmth, water, light, aeration, anchorage and nutrients. In order to grow orchids well it is essential to understand how their individual needs are met by their structural adaptations to their natural habitat. The detail are shown as follow (9):

2.4.1 Temperature

Orchid are classified into 3 categories on the basis of their temperature requirement:

1) The cool-growing orchids

These orchids grow best at night temperatures of 10-13 °C and day temperatures of 16-21 °C.

2) The intermediate group

These orchids prefer night temperatures of 10-16 °C and day temperatures of 21-29 °C. *Dendrobium* sp. belongs to this group.

3) The warm-growing orchids

These orchids require night temperatures which are consistently above 16 °C for proper growth.

2.4.2 Water and humidity

Orchid are well adapted to dry conditions and are often none the worse after several days without water. In their natural environment they can tolerate drought or just as easily withstand weeks of heavy rainfall. The frequency with which one should water the plants depends, among other things, on: the way the plant is grown: pot or slab, potting media, type of pot, size of pot, drainage provisions in the pot; atmospheric temperature; light intensity; air movement; the condition of the plant; and the species, and whether it is epiphytic or terrestrial.

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As a rule, atmospheric humidity of 40 to 50% is ideal for orchid cultivation in temperate countries. A humidity of 70 to 80% is preferred for orchid grown under shade in tropical countries. Orchids grown in full sun may require a humidity in excess of 80%. Many commercial greenhouse in Thailand keep the ground in their lath houses soaking wet to promote rapid growth of seedlings. However, orchid leaves do not absorb water from the atmosphere if the humidity is less than 98.8%, unless the plant is suffering from great water deficit, when it can absorb water from the atmosphere at 92% humidity.

A few orchid have been grown successfully by hydroponics and in the Luwasa system, but this requires a larger capital investment and is really more complex. Instead of watering by hand, a sprinkler system can be installed and set to go off either at a set time of the day or when the humidity reaches a critical level. In commercial greenhouse, these devices are not frequently used as it takes a worker very little time to hose down all the plants in the greenhouse.

In the confined space of a glass house orchids need not be watered more than once every 3-4 days in a cool climate, but in summer and in tropical areas it is necessary to water once a day. There are two ways to water the plants: drench them until they are dripping wet or spray a fine mist along the rows of plants so that only the leaves and the surface roots are wet. If the plants are grown in the open and there is strong air movement around them, they should be drenched at every watering. For epiphytes grown under shelter in a lath house or in a greenhouse, most agriculturist will use fine spray to economise on water usage, fertilizer and chemicals. The orchid roots and its contact surfaces soak up water within a few seconds and continued watering merely causes the excess to run off.

2.4.3 light

Orchids require 25-50% shade in summer if they are cultivated in temperate countries and throughout the year if they are grown in the tropics. The *Dendrobium* sp. belongs to this group. In choosing a site for orchid cultivation, you would select a plot which faces east, that is, it receives full morning sunlight. The reason is not so much the quality of light but the temperature. A plot which faces were is warmer and the plants are more likely to suffer from heat shock and water stress.

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2.4.4 Aeration

Commercial agriculturists in the tropics pay a lot of attention to wind movement when selecting a site for an orchid greenhouse. Strong wind movement is favourable and a good site should have sloping terrain and should not be obstructed by tall structures. Orchid leaves are heated by radiant energy and can only lose this heat by conduction into the atmosphere. It is therefore important to have good air movement and high humidity around the plant since water conducts heat more efficiently than dry air. If the plants are watered in the evening, a strong air current will also lower night temperature and induce flowering. Some agriculturists also believe that drying the leaves and crown by air movement prevents bacterial and fungal rot.

2.4.5 Nutrients

There is no doubt that orchids benefit from the application of fertilizer and it is difficult to believe that popular opinion once maintained that it was unnecessary to feed the plants at all or that it was even harmful. Dr.Davidson's explanation of the reasons behind this misconception is to the point, once photosynthesis begins the orchid plant requires nitrogen, phosphorus, potassium, boron, molybdenum and manganese. Under optimum light and heat, orchids will grow better (and often to a tremendous size not usually seen in nature) if they are constantly supplied with organic fertilizer. The amount of fertilizer required by the plant and the balance of the nutrients are dependent on the species, the stage of growth, potting medium and growing conditions.

Ministry of Agriculture and Cooperatives policy is to support agriculturalists of having a standard management system on the quality of Good Agricultural Practice (GAP) (10).

2.5 Situation of orchid production and orchid export market in Thailand

Thailand is the first rank of the exportation source on the tropical orchid then Thai orchid was the important exportation agricultural products of Thailand. The income values from its exportation, was more than 1,500 million bahts and its

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tendency was growth continuously. According to the income values from Thai orchid exportation, the Ministry of Agriculture and Cooperatives (Thailand) is set to be one of the best four agricultural product champions of Thailand and support its exportation.

Export orchid production was divided into 3 categories as follows (11)

1) Flower production - This production related to the cut-flower orchid for exportation. The cut-flower orchid would be ordered and limited both quantity and quality of the product from the exportation company. For the cut-flower orchid that lack of quality or exceed for exportation, will be sold in Thailand.

2) Orchid trunk production - This production related to the cultivation of the orchid trunk for exportation. Thai orchid had been accepted by foreign country both types, colour, trunk those can use for cultivation or use the blossom orchid trunk for the interior decoration.

3) Orchid trunk production in sterile condition - This production related to the employment for propagated the orchid trunk production for the owners of orchid garden.

The quantity of the cut-flower orchid industry area B.E.2546 was 19,399 rais. That found increasingly growth at 8.28% per year and it can expected, in B.E.2551, amount of the cut-flower orchid industry area will expanding to 29,000 rais. Source of the cut-flower orchid industry area is in Bangkok Metropolitan area and neighbor areas such as Samutsakhon, Nakhonpathom, Ratchaburi, Kanchanaburi, Ayutthaya, Nonthaburi and Pathumthani Province because these areas were appropriated for transportation cultivation and convenience for exportation.

The number of the orchid agriculturists was 2,500 persons. Most of them were own a few area (5-10 rais). They often assembled their areas for use on the orchid cultivation. The other orchid agriculturists have the area around 100-500 rais (12). Types of the cut-flower orchid that most expanding cultivated was *Dendrobium* spp. (80%), The remaining types of the cut-flower orchid (20%) was the other species such as *Vanda* spp., *Mokara* spp., *Oncidium* spp., *Ascocenda* spp., *Aranda* spp. And *Cattleya* spp.

Statistics of the quantity and income value of orchid exportation in Thailand from the Office of Agricultural Economics and the Customs Department, Ministry of Finance that illustrated in Table 2-4 (1).

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Table 2-1 Quantity (ton) and income value (million baht) of orchid exportation in Thailand

Month	1999		2000		2001		2002		2003		2004	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Jan	993	89.73	489	59.61	1,606	129.18	1,191	132.02	1,403	134.74	1,744	180.67
Feb	908	78.15	616	64.43	1,085	116.26	1,282	137.57	1,262	139.24	1,419	151.38
Mar	1,148	92.55	480	52.91	1,040	111.73	1,232	139.29	1,531	174.88	1,558	172.28
Apr	743	68.65	1,261	91.33	974	111.08	965	106.12	1,294	142.22	1,411	159.25
May	809	67.89	869	105.33	1,060	119.8	1,145	136.54	1,223	155.12	1,218	153.71
Jun	719	59.20	756	75.68	868	101.49	953	109.46	1,051	132.43	1,064	132.09
Jul	812	67.12	856	87.56	901	99.03	952	104.83	1,126	137.41	1,018	130.76
Aug	1,859	87.13	1,065	107.90	1,146	128.14	1,219	138.20	1,368	162.93	1,429	181.31
Sep	1,166	106.58	1,300	131.97	1,340	146.93	1,424	167.18	1,743	206.81	1,819	205.53
Oct	1,448	133.54	1,601	160.46	1,544	162.06	1,691	179.10	2,119	236.75	2,162	241.98
Nov	1,884	109.82	1,140	128.30	1,164	124.91	1,348	143.16	1,524	159.6	1,847	206.27
Dec	1,335	100.66	1,345	165.75	1,213	143.97	1,569	159.58	1,776	203.3		
Total	13,125	1,061.05	11,778	1,231.23	13,941	1,494.58	14,971	1,653.05	17,420	1,985.43	16,689	1,915.23

source: (1) (updated 28/12/2004)

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This table exhibited the situation of the quantity and income value of orchid exportation for 5 years ago. The quantity and income value of orchid exportation was increasing in every years and the income value of orchid exportation depend on grade and season.

From the situation analyze of the cut-flower orchid industry in Thailand, there was some problems in 3 categories as follows (12):

1) Production line

- Lack of technology for supported the improvement the cut-flower orchid industry in order to increase both quantity and quality of the product
- Lack of the genetics development to supported the improvement the cut-flower orchid industry
- Lack of technology to support the preservation the cut-flower orchid

2) Transforming process

- Lack of new technology in transforming process

3) Marketing

- Lack of the market fair of the cut-flower orchid
- Lack of the promotion of Thai orchid image
- Exporters are cut their prices
- Area of hold of a ship is not enough

According to these problems, then new vision about Thai orchid was occurred. The purpose of the new vision was to improve the quality and the variety of Thai orchid to meet the world standard and to improve Thailand orchid market to the world center of the orchid industry. There are research and development plans as follows:

- Research for solve the thrips problem
- Research and development the orchid gene including theirs conservation
- Research and development the production line for improve the quality of the orchid
- Research and development the production line by use the appropriated technology

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All of these expect to the usage of the production technology for specified the efficiency production process that accordingly with the exportation standard. Tendencies for development the orchid industry had been presented as follows:

- Support in the development the orchid gene including their conservation
- Support the gardener to gather together for development their production
- Support the registration of the exporter for specified the standard of the exportation quality in the same way.
- Support the continuously of the production activities and the marketing for added the exportation income value.
- Campaign for the appropriated orchid production which lead to the good image of Thai orchid on the safety for health and environment.

2.6 Diseases of orchids

Diseases of orchids can be classified under the following categories (9):

1) Genetics:
   - Inbreeding
   - Aneuploidy
   - Polyploidy (excessive)
2) Nutrition and environment:
   - Water (insufficient or excessive)
   - Light (insufficient or excessive)
   - Nutrients (insufficient or excessive)
   - pH (alkalinity or excessive acidity)
3) Infections:
   - Stress Factors
   - Viral
   - Bacterial
   - Fungal

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4) Infestations:

- Arthropods
- Snails

Genetic disorders are inherent in the plants and cannot be avoided. At present there is no treatment for viral disease. However, destruction by pests and fungal disease and loss of plants through poor cultural technique can easily be prevented by paying proper attention to the specific needs of the plants. Good management involves consideration of factors such as choice of site, housing, cleanliness, good ventilation, suitable humidity and rotation of fertilizers. Spraying with fungicides and insecticides also helps to prevent disease in orchid plants.

2.6.1 Genetic disorders

Genetic disorders in plants are expressed by slow or anomalous growth, freak flowers and sterility. They may result from mutation, repeated selfing (self-fertilization), through hybridization, exposure to chemicals, radiation and perhaps to viruses.

The rare forms of species which are highly prized, e.g. the alba forms, are usually due to recessive traits which can only be guaranteed in the next generation by selfing the plant. Besides, selfing is also employed by farmers to multiply uncommon hybrids and to improve and fix the special characteristics possessed by the plant in question. Repeated selfing inevitably leads to an accumulation of multiple recessive traits and a loss of hybrid vigour.

Freak flowers and abnormal growth are not invariably due to bad genes. It is quite common for a health plant to produce freak flowers and abnormal leaves when it has been given an excess of fertilizer or if growth hormones and other chemicals are applied, particularly at the time of flower spike initiation.

2.6.2 Viral diseases

Viral diseases are spread by man, through cutting tools, and by insect vectors. There is no doubt that viral diseases eventually sap the vigour of the plant, causing poor flower production, distortion of stems, leaves, flower spikes and flowers, as well as color break and bud drop. In the early stages these symptoms may be totally or partially suppressed by good cultural technique and heavy fertilizing. Viral diseases cannot be climinated through chemical to the problem.

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The risk of transmitting virus from plant to plant can be reduced by dipping cutting tools in a saturated solution of trisodium phosphate or by flaming such tools after cutting each plant. Badly affected plants should be discarded. An effective insecticide programme reduces the risk of virus transmission by insect vectors.

The main viral diseases of orchids are:

1) *Cymbidium* Mosaic Virus,
2) Cymbidium Necrotic Ringspot Virus,
3) Tobacco Mosaic Virus, 'Orchid' type (O type), and
4) Odontoglossum Ringspot Virus.

The commonest symptoms of viral infection are:

1) irregular, yellow patches on the leaves (chlorotic mosaic);
2) pitting, black flecking, streaking or spotting on the leaves (e.g. necrotic mosaic in Onc. Goldiana var. Golden Shower, Den. Pompadour, Cattleya);
3) yellow, brown or black ring patches (ringspot);
4) color break in the flowers;
5) bud drop; and
6) brown, necrotic streaks on the flowers.

2.6.3 Bacterial and fungal diseases

Bacterial and fungal diseases are commonly present as soft, soggy, translucent, circular patches on the leaves. In the case of bacterial rot the patch enlarges rapidly and soon covers the entire leaf. Gradually the disease spreads to the roots and pseudobulbs and may destroy the whole plant if prompt treatment is not given. Some fungal diseases are present as yellow spots or black patches on the leaves and stems. These spread quite slowly and there is ample time to control the infection. In addition to providing good air circulation, protecting seedling and softgrowing orchids such as *Phalaenopsis* from rain (and using discrimination about watering during the rainy season), prophylactic spraying with fungicides is a widely practiced method of control. Where infection is already present, the practical steps to take are:

1) Increase the ventilation, if possible.
2) Withhold watering and stop the spraying of organic fertilizer.
3) Isolate badly affected plants.
4) Trim off all badly affected leaves and flowers.

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5) If the stem or pseudobulb is affected, prune down drastically to reach clean, healthy tissue and then remove an additional portion of healthy tissue to be on the safe side.

6) Apply a paste of fungicide on the raw edges of leaves, stems and pseudobulbs.

7) Discard any inexpensive, badly affected plant.

8) Discard infected potting medium. If the pots are to be re-used they should be washed and sterilized by soaking in a 2 percent formalin solution; clay pots may be flamed.

9) Spray the entire collection with at least two fungicides.

10) Finally, check the plant house for leaks and repair them.

Bacterial and fungal diseases namely was Bacterial brown spot, Bacterial soft rot, Bacterial Leaf rot, Brown rot of *Paphiopedilum*, Crown rot, black rot, damping off, Root Rot, *Anthracnose* or leaf spot fungus, *Fusarium* flower blight and leaf spot, *Curvularia* flower blight, *Cercospora* leaf spot, *Phyllostictina* leaf spot, Snow Mould and Sooty Mould.

2.6.4 Pests

The extent and type of damage caused by an orchid pest depends on the severity of the infestation and on the feeding habits of the particular pest. Mites and insects generally cause damage to foliage, flowers and stems, while slugs and snails destroy roots and foliage. Burrowing and sucking insects introduce serious viral, bacterial and fungal diseases and they are much more serious than caterpillars or grasshoppers which merely chew off leaves and flowers.

2.6.4.1 Spider mites (*Tetranychidae*)

Mites are 8-legged arthropods and both the spider mites (red spiders) and the false spider mites are serious pests on all tropical orchids. The spider mite spins fine webs which may be detected on the flower spikes and along the edges of leaves and floral segments.

The best control is Dimite (diparadhlorophenyl methylcarbinol or DMC), a compound closely related to DDT. Malathion and Roxion are also effective.

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2.6.4.2 False spider mites

False spider mites cause severe destruction of affected foliage with pitting, chlorosis and death of the leaves. They are particularly disastrous for *Phalaenopsis*.

The best control is with Dimite, Kelthane or Chlorobenzilate. They are not killed by Malathion. Hot, dry weather encourages their development and frequent fine spraying with water helps to keep their population down.

2.6.4.3 Thrips (*Thysanoptera*)

Thrips are small, flying or jumping insects about 1 mm long. They feed on leaves and flowers, causing fine silver specks which completely ruin the flowers. They commonly attack flower buds of orchids and hide within them, in the meantime sucking the juices from the unopened sepals and petals which are disfigured when they open. The insects are yellow-grey or black and their presence is easily recognized by the black excrement which they deposit on the infested parts.

Many insecticides including Roxion, DDT, BHC (benzene hexachloride, lindane) will easily eliminate thrips but perhaps the cheapest and safest is Dipterex (trichlorophane) which is biodegradable.

2.6.4.4 Scale insects

Soft scales (*Coccidae*) and armoured scales (*Diaspididae*) commonly affect orchids but they generally do little damage compared with mites, thrips and weevils. They are found on the under surface of leaves and on the stem. The young stages are free-moving but when they mature they stick their proboscis into the tissues and remain there. Good control is provided by spraying with Malathion or while oil (Albolinum).

2.6.4.5 Aphids (*Aphidae*)

Aphids or plant lice are soft-bodied green or black insects which are incidental pests. They suck the sap and excrete honeydew on new spikes, flowers and foliage. Their principal threat to orchids is serious because it is insidious-they transmit viral disease. The female produces living young which take a week to mature. Malathion provides satisfactory control.

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2.6.4.6 Mealy bugs (*Pseudococcidae*)

These are also incidental pests sometimes affecting *Phalaenopsis*. The adults are 0.5-1 cm long and are covered with a whitish powder and long, waxy filaments. The eggs are produced in cottony egg sacs and hatch in 4-10 weeks, becoming adult in 2-3 months.

Parathion provides the best control but Malathion is satisfactory.

2.6.4.7 Weevils

These are a great scourge today, particularly because the grubs bore through the growing stem and destroy the entire plant. The adult weevils are 0.5-1 cm long, black and easily recognized by their long snouts. They are best detected in the early morning when they come out to feed. Several generations are produced a year.

2.6.4.8 Beetles

It lays its eggs on the flowers and the slimy, brick-red grubs feed on the flowers. The damage is usually restricted to the flowers; cutting off entire sprays and burning them appears to be a simple way for control. If the plants are regularly sprayed with pesticides these beetles are seldom seen. Long-horned beetles are also reported on orchids in Southeast Asia and bug beetles attack *Dendrobium*.

2.6.4.9 Caterpillars

A good pesticidal programme generally keeps the butterflies at bay. A variety of butterflies lay eggs on *Phalaenopsis* seedling and on the developing buds of other vandaceous orchids and *Dendrobium*. The caterpillars bore into the buds and cause extensive damage to the flowers. Once infested, the entire spray should be removed and burnt.

2.6.4.10 Snails

Garden snails attack orchids within their reach. The tiny bush snails which hide in the charcoal and crock within the pots are particularly troublesome. They eat up young leaves, flowers and the tender root tips.

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2.6.5 Pesticides

For use on orchids, pesticides must be dissolved only in water; the solvents used for household insecticides, for example, are toxic to plants. All insecticides are poisonous to man and must be handled with care. With regard to the insecticides which are available, the degree of safety associated with their usage depends on two main factors: (1) the lethal dose, with LD50 as a reference number and (2) whether the pesticide is biodegradable or whether it has a cumulative effect.

Organic phosphates are nerve poisons which are extremely poisonous to man, with the exception of Malathion. Because they are all cumulative poisons, even Malathion must be handled with care. Benzene hexachloride (BHC), DDT and Dimite (DMC) are chlorinated hydrocarbons which also have a cumulative effect, with DDT having particularly important consequences on the environment. Their toxicity varies from being relatively harmless (Aramite) to moderately toxic (Benzene hexachloride). DDT is banned in many countries but is still used in some countries where the control of malaria carrying mosquitoes remains a prime concern. Dipterex is relatively safe. Plant derivatives such as rotenone (Derris) are relatively nontoxic.

2.7 Biotechnology

"Biotechnology" has been defined by the Office of Technology Assessment of the United States Congress as "any technique that uses living organisms, or parts of organisms, to make or modify products, to improve plants or animals, or to develop micro-organisms for specific uses" (13).

The application of biotechnology to environmental problems is one of its areas of greatest potential. Biotechnology has already contributed to a safer environment, with many anticipated breakthroughs on the horizon. A few examples of areas where biotechnology has already had an impact include the replacement of environmentally hazardous pesticides with safer biotechnologically-produced pesticides, the development of new microbial techniques for cleaning up pollution, the creation of alternative fuels that are less environmentally damaging, and the formulation of new biodegradable materials (14).

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Biotechnology promises to expand the set of tools at our disposal for control of pests in agricultural production systems. Natural and engineered microbial pesticides are being developed to control a variety of lepidopteran pests (15). Some of these biological pesticides may act as replacements for environmentally persistent chemicals, quickly breaking down into harmless components and thus reducing residue problems (16).

New developments in agricultural biotechnology are being used to increase the productivity of crops, primarily by reducing the costs of production by decreasing the needs for inputs of pesticides and herbicides, mostly in drops grown in temperate zones (17). MI (Microbial inoculants) applications have been approved effective in many aspect and played important roles in promoting crop productions and purifying the environment (18).

The improvement of agricultural, horticultural and forestry production aims at increasing the yields of cultivated plants, at obtaining foodstuffs with a higher nutritional value, at selecting cultivars with greater resistance to adverse weather condition, to pathogens and pests, and at creating varieties adapted to particular climatic and soil conditions (19).

2.8 Effective Microorganism, EM

EM is an abbreviation of Effective Microorganisms. A mixture of groups of microorganisms has a reviving action on humans, animals, plants, and the natural environment. It is a concept which is environmental friendly and cost effective through waste recycling developed in the fields.

EM promotes the germination, growth, flowering, fruiting and ripening in crop plants. EM enhances the photosynthetic capacity of plants and increases the efficiency of organic matter as fertilizers. EM develops resistance of plants to pests and diseases. EM improves the physical, chemical and biological environments of soil. EM suppresses soil borne pathogens and pests.

It can convert all kinds of crop residues, farmyard manure, poultry manure, and sugarcane filter cake or press mud and solid municipal waste into high quality

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biofertilizer within 10 days. Increasing the utilization efficiency of solar energy from maximum crop production as the actual utilization rate is less than 3% as against 10-20%. The best opportunity for increasing biomass production is to utilize the visible light, which cannot be used by chloroplasts and the infrared radiation energy.

In the presence of organic matter, photosynthetic bacteria and algae can utilize wavelengths ranging from 700-1200 nm. Fermenting microbes could also breakdown organic matter, thereby releasing complex compounds such amino acids for utilization by plants. This enhances the efficiency of organic matter in crop production.

2.8.1 Banana cultivation with EM- Technology

Banana is heavy surface feeder crop, as feeding roots lie in the upper 6 layer of soil, hence it require heavy manuring. The application of irrigation water through fermentor resulted an increased leaf area index followed by thick green color and huge number of earth worms and other biological entities developed inside the soil which are serving as the natural tilth of the soil, the roots of banana plant taken up nutrients and water easily with increased biological activities.

This practice has reduced our cost in terms of working with tools, chemical synthetic fertilizers and labor. Banana fruit produced increased number of hands, size of finger and color of fruit only after application of effective microbes.

2.8.2 Sugarcane cultivation with EM- Technology

Asim Agriculture Farm has achieved higher yield of sugarcane by using EM technology, Sugarcane recovery percentage of EM-treated sugarcane variety (PR-1000) was 11.5% whereas, the recovery percentage of un-treated sugarcane was 8.1%.

The Yield of sugarcane of EM-treated sugarcane were 1,900 maunds/acre from 47 acres whereas, the yield of sugarcane of un-treated were 1,500 maunds/acre from 50 acres.

2.8.3 Mango cultivation with EM- Technology

Organic manure for mango orchard grown in mulch culture along with EM-Technology This report presents effective microorganisms application guidelines for a ring, mulch culture system for mango orchard.

This information has been developed from results of research in Asim Agriculture Farm Tando Allahyar.

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1) This has increased biological life inside the soil. (Earthworms and certain other microbes)

2) The roots of mango trees have a tendency to move with water films and available nutrients inside the soil. The application of bokashi and irrigation through fermentor helped a lot in root hair development within a circle. Most of the water and nutrients are taken up by the root hairs.

3) The organic compounds are decomposed by the action of effective microbes into inorganic molecules which are taken up easily by the mango tree consequently the vigorous vegetative growth give a healthier look of mango trees.

4) Mulching keeps proper moisture, weed control and more importantly a safe house for mango tree rhizosphere.

The 21st century has dawned, with renewed hope for a better livelihood for the populations of this earth. Hence the themes often discussed at international forum on human welfare and agriculture range from sustainability, food security and safety to the provision of a productive and healthy environment to humankind and its future generations. Hence there is often a great deal of optimism about the possibilities of solving the multitude of problems in relation to the provision of food and a clean healthy environment for all.

The potential of EM in agriculture and environmental management is significant. The technology can be used easily and economically to enhance productivity of agricultural systems, especially organic systems and in mitigating environmental pollution (18).

Awareness about the beneficial effects of microorganisms, and earthworms is on the increase today. Organic farmers now have the option of using simple and low cost bioformulations that significantly increase the crop yield. The “effective microorganisms” technology developed by Professor Teruo Higa of Japan is a combination of composite microorganisms that boost agricultural and horticultural production. This mixed culture of beneficial microorganisms was found to be more effective in boosting crop growth than any of its constituent species acting in isolation. He named this group of beneficial organisms, consisting of almost hundred organisms as “Effective microorganisms” (EM). According to Dr. Lucas Dengel of Auroannam

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at Auroville, EM consists mainly of *Lactobacillus*, photosynthetic bacteria, yeast, fungi and actinomycetes. It is now becoming popular in India.

EM counteracts rot, odor and rust, and is hence widely used for treating wastes. EM technology also has applications in dairy, poultry and aquaculture. A number of recipes and application schedules have been developed. In Auroville, EM was used in a small dairy. It helped in controlling bad odour, flies and general health of the cattle improved. Dr. Dengel also observed that festering wounds in cattle, which defied various kinds of treatments, were healed, and the milk yield increased by 13 percent (20).

2.9 General information in economic and social at Nakhonpathom Province

Nakhonpathom is a province located in the middle part of Thailand that far from Bangkok approximately 30 km. It has enormous economic and natural resources, including the down plain lands suiting with agriculture. Each area produces different agricultural products depending on its landscaping nourishment. Sampran District is one of the seven districts in Nakhonpathom Province of its producing agricultural varieties. Sampran District consists of sixteen Tambons (21).

2.9.1 Location

Sampran District is located in the south of Nakhonpathom Province and far from the centre of Nakhonpathom Province approximately 21 km.

2.9.2 Area

Sampran District has its lands approximately 249,374 km^2 (155,841.88 rais)

2.9.3 Geographical

The district geographical areas can be categorized as:

1) North of district reaches Nakhonchaisri District; Nakhonpathom Province

2) South of district reaches Muang; Nakhonpathom Province, Kratumban District and Banpaeo District; Samutsakorn Province

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3) East of district reaches Phuttamonthon District; Nakhonpathom Province, Thaweewattana District and Nongkaem District; Bangkok Metropolis

4) West of district reaches Muang; Nakhonpathom Province

2.9.4 Political

Sampran District consists of sixteen Tambons (140 villages) as follows:

Table 2-2 The number of villages in each Tambon at Sampran District

Tambon	Number of village
Sampran	9
Bangchang	11
Banmai	5
Omyai	8
Bangkratuk	8
Klongjinda	14
Klongmai	6
Bangtoey	7
Raiking	14
Kratumlom	9
Yaicha	6
Taladjinda	11
Thongkanong	6
Takam	6
Tatalad	10
Homkret	10
Total	140

2.9.5 Topography

Nakhonpathom is located in an alluvial plain in the central region. Generally, it is an area of alluvia plain which is drained by the Tha Chin River, covering an area of 2,168,327 km^2 or about 1,355,204 Rai^2. Then, almost of agriculturists used water from this for agricultural and it is enough all over year. Some

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of agriculturists used rain water and its average volume was 1,022 mm/year. The highest rain is in August, September and October in every year. So, temperature and humidity is very proper for agriculture.

2.9.6 Population and economic situation

Nakhonpathom is the one of agricultural province. There are 148,130 peoples (70,270 males and 77,860 females) in Sampran District. Agricultural area and household at Sampran District are 58,148 rais and 8,275 household, respectively. The average of agricultural income is 88,154 baht / household / year. The agricultural area is divided into many categories as follows:

1) Paddy field	7,648	rai
2) Orchards	45,260	rai
3) Vegetation area	210	rai
4) Flower area	3,491	rai
5) Other crop area	1,959	rai

Table 2-3 Information of economical crops

Economical crops	**Plantation area (rai)**	**Quantity of product (kg)**	**Value (million baht)**
Guava	12,748	57,366,000	229,464,000
Rose apple	7,672	19,180,000	287,700,000
Coconut	6,822	29,334,600	73,336,500
Pummelo	5,753	20,135,500	402,710,000
Orchid	3,386	33,860,000	135,440,000
		Total	1,128,650,500

Table 2-4 Information of orchid plantation area in Sampran District

Tambon	**Plantation area (rai)**
Sampran	553
Bangchang	720
Banmai	315

Table 2-4 Information of orchid plantation area in Sampran District (Cont.)

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Tambon	Plantation area (rai)
Omyai	177
Bangkratuk	330
Klongjinda	308
Klongmai	239
Bangtoey	36
Raiking	156
Kratumlom	94
Yaicha	105
Taladjinda	170
Thongkanong	20
Takam	17
Tatalad	47
Homkret	99
Total	3,386

2.10 Related researches

A field experiment was conducted to determine the effects of integrated use of organic and inorganic nutrient sources with effective microorganisms on growth and yield of cotton. Treatments included: control; organic materials (OM); effective microorganisms (EM); OM+EM; mineral NPK (170:85:60 kg); 1/2 mineral NPK+EM; 1/2 mineral NPK+OM+EM and mineral NPK+OM+EM. OM and EM alone did not increase the yield and yield attributing components significantly but integrated use of both resulted in a 44% increase over control. Application of NPK in combination with OM and EM resulted in the highest seed cotton yield (2,470 $kg.ha^{-1}$). Integrated use of OM+EM with 1/2 mineral NPK yielded 2,091 $kg.ha^{-1}$, similar to the yield (2,165 $kg.ha^{-1}$) obtained from full recommended NPK, indicating that this combination can substitute for 85 kg $N.ha^{-1}$. Combination of both N sources with EM also increased the concentrations of NPK in plants. Economic analysis suggested the use of 1/2 mineral NPK with EM+OM saves the mineral N fertilizer by almost 50% compared to a

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system with only mineral NPK application. This study indicated that application of EM increased the efficiency of both organic and mineral nutrient sources but alone was ineffective in increasing yield (22).

The influence of effective microorganisms (EM), a commercially available microbial inoculant containing yeasts, fungi, bacteria and actinomycetes, was evaluated in field trials of commercially produced, irrigated vegetable crops on "organic" farms in Canterbury, New Zealand during 1994-1995, and in a laboratory incubation. EM plus molasses were both applied, at 10 $L.ha^{-1}$ in 10,000 $L.ha^{-1}$ water, three times to the onions, twice to the peas and seven times to the sweetcorn. EM plus molasses increased the onion yield by 29% and the proportion of highest grade onions by 76%. EM plus molasses also increased pea yields by 31% and sweetcorn cob weights by 23%. A four week incubation at 30°C of loamy sand and 1% w/w pasture litter had treatments including a control, glucose, and EM plus glucose, and captured respired carbon (C) using NaOH traps. By the end of the incubation the glucose treatment had respired 38% more C than the control. The EM treatment respired an additional 8% more C than the glucose treatment. Using EM stimulated C mineralization in the laboratory incubation, but a corresponding increase in mineralization of organic nitrogen, phosphorus and sulphur was not measured (23).

EM Technology was introduced into Auroville's farms in October 1999. It was first used in agriculture through spraying, and then with EM compost and Bokashi. Later EM5 and Fermented Plant Extract (FPE) in combination were used for Pest Management. It was next introduced for animal husbandry, mainly for sick cows (wounds, legs problems, flies, larvae, fungus, mastitis, diarrhea, skin problems, injuries, and ticks).

Today EM is widely used in the cultivation of crops, vegetables and animal husbandry. It is either sprayed and used in composting, or to make Bokashi. It is also used as EM5 and FPE.

The main materials used to make compost are leaf litter, coconut leaves, banana trunks and banana leaves, charcoal, kitchen waste, cow dung, horse dung, sawdust, chicken manure, waste flowers, bonemeal and ash. Auroville's Bokashi is prepared with the following ingredients:

- Oil Cake..... 2.29%

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- Broken rice.....22.94%
- Rice bran.....53.54%
- Green gram.....5.62%
- Black gram.....7.50%
- Millets..... . 3.06%
- Horse gram.....3.06%
- Salt.....1.99%
- Organic jaggery (molasses)
- EM extended solution
- Water

After using EM Technology in Auroville's farms for 1.5 years, the achieved results as the following:

Agriculture

- In peanut crops, the biomass increased by 34%, the density (plant number/m^2) increased by 25% and the yield increased by 43%.
- In soybeans crops, the biomass increased by 40% and the density increased by 69%.
- In groundnut, black gram and green gram crops, the biomass increased 72% and the density increased 18%.
- Rice yields increases in the first year of application.
- Maize and sugarcane grew taller by 33%.
- For papayas the income increased by 150%.
- Cashew yields increased by 47.5%.
- Mango yields increased by 15%
- Guava yields doubled.
- Bigger sizes were recorded in sweet potatoes and tapioca.
- The farm workers attitudes towards EM have been very positive, as they have realised it can be 100% organic.

Pest Management

- Black sigatoka in bananas is controlled.
- Eriophyd mite in coconuts is controlled.
- Rhinoceros beetle in coconuts is controlled.

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- Tea mosquito bugs, nut borers, leaf miners, webber, leaf folders and flower thrips in cashews are controlled.

- Caterpillars and bugs in vegetables are controlled.

- With cow urine included the fungus attack in guavas is eliminated.

- With a preparation of fish meal and EM, fungus in mangoes is controlled

- In tomatoes and brinjal, bacteria wilt is controlled.

- In orchids, virus-bacteria and fungus are controlled.

- The Matrimandir gardens are visited every day by thousands of people. The rose gardens are under a special program of mulching, ash, EM and FPE.

- The most dramatic results were in citrus species affected by Gummosis (Diplodia natalensis); used together with copper sulfate, all of them recovered from very bad damage.

- Fruit trees affected by two of the most virulant pathogens; *Phytophthora nicotianae* and anthracnose (*Colletotrichum gloeosporioides*) are controlled.

- During monsoon, fungus attack on human feet is eradicated. By using FPE for all fungus problems, using EM+EM5+neem oil against insects and using EM+EM5+FPE for controlling all insects and diseases (24).

The use of EM in agriculture and horticulture has not only resulted in increased yields, but has also improved quality and increased shelf-life of the produce. In EM farming practices, special recipes are prepared to manage pests and diseases. EM application demands liberal addition of organic residues as these microbes feast on carbon and the organic wastes also encourage the synergy of all aerobic and anaerobic organisms (14).

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CHAPTER III
RESEARCH METHODOLOGY

This research was experimental and survey study. It was divided into 4 parts including: I) to survey the orchid production technology in Sampran District, Nakhonpathom Province; II) to determine the physical, chemical and biological characteristics of EM; III) to study the efficiency of EM to increase productivity, quality improvement and plant disease protection in the orchid (*Dendrobium* sp.) cultivation and IV) to propose a guideline for *Dendrobium* sp. cultivation by using biotechnology application.

3.1 Materials and equipment

1) Autoclave (HIRAYAMA HV-85)
2) Hot air oven (CONTHERM CAT 260 M)
3) Microbiological safety cabinet (ATLAS 2000)
4) Incubator (Jermaks series KB 8400, KB 8400F, FL)
5) Scientific glassware
6) Greenhouse for *Dendrobium* sp. cultivation: Kij's greenhouse, Tambon Salaya, Phuttamonthon District, Nakhonpathom Province.

3.2 Chemical reagents and cultural media

1) Magnesium sulfate heptahydrate ($MgSO_4.7H_2O$)
2) Ammonium sulfate ($(NH_4)_2SO_4$)
3) Potassium di-hydrogen phosphate (KH_2PO_4)
4) Di-Potassium hydrogen phosphate (K_2HPO_4)

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5) Zinc sulfate heptahydrate ($ZnSO_4.7H_2O$)
6) Manganese (II) sulfate tetrahydrate ($MnSO_4.4H_2O$)
7) Calcium Chloride ($CaCl_2$)
8) Cobalt (II) Chloride hexahydrate ($CoCl_2.6H_2O$)
9) Di-Sodium hydrogen phosphate heptahydrate ($Na_2HPO_4.7H_2O$)
10) Copper (II) sulfate pentahydrate ($CuSO_4.5H_2O$)
11) Ferrous sulfate heptahydrate ($FeSO_4.7H_2O$)
12) Manganese sulfate heptahydrate ($MnSO_4.7H_2O$)
13) Glucose
14) Peptone
15) Yeast extract
16) Agar
17) Actidione
18) Ferric citrate
19) Thiamine hydrochloride

3.3 Orchid cultivar

Dendrobium sp. was purchased from Dhanakorn farm located in Tambon Bangchang, Sampran District, Nakhonpathom Province.

3.4 Survey the orchid production technology in Sampran District, Nakhonpathom Province

3.4.1 Target population

The target population of this research consisted of agriculturists who cultivated *Dendrobium* sp. in study area and their names were in the list of orchid exportor in year 2000 (25) (Appendix B). It was divided by Tambon as shown in Table 3-1.

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Table 3-1 Number of *Dendrobium* sp. cultivations'agriculturist in study area in year 2000

Tambon	Number (case)
1. Sampran	56
2. Bangchang	36
3. Banmai	34
4. Omyai	23
5. Bangkratuk	21
6. Klongjinda	18
7. Klongmai	12
8. Bangtoey	3
9. Raiking	3
10. Kratumlom	2
11. Yaicha	2
12. Taladjinda	1
13. Thongkanong	1
14. Takam	1
15. Tatalad	1
Total	214

Source: (25)

3.4.2 Sample size

The number of agriculturists who registered with Department of Agriculture Extension was 214 case. The statistic analysis was performed base on a 90% confidence interval (C.I.). The sample size was determined by Taro Yamane equation (26) described as follows:

$$n = N / 1+Ne^2$$

when, n = sample size

N = number of population

e = sampling error at a 90% C.I. = 0.10

Thus, this study; $n = 214 / 1+ 214 (0.10)^2$

$= 68$ samples

From this result, 68 farms were selected for survey by the questionnaire.

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3.4.3 Research questionnaire

The interview-questionnaire (Appendix C) was used to collect the information from the agriculturists. The both open and close end questions of questionnaire comprised of 5 parts as follows:

Part I: Agriculturist's personal information

Part II: General information of farm

Part III: Method for increasing and improving the quantity and quality of product.

Part IV: Method for plant diseases and plant pests protection and weeds control

Part V: Knowledge and usage of EM for the orchid cultivation

The questionnaire was recommended and improved by research committees and then try out to 3 agriculturists who work in another area. The version of developed questionnaire was used in this study.

3.4.4 Data collection in the field study

The data were collected via questionnaires. The proportion to size method was used to estimate the sample size of agriculturists in each Tambon. This method would evenly and uniformly give the distribution of sample in order to be a good representative of the target population. From the estimation of total amount of sample size in the previous section, the total amount of sample cases is 214 agriculturists from 15 Tambons. The sample size calculated by Taro Yamane equation was 68 that covered only 11 Tambons. It would be distributed into each Tambon by using proportion of agriculturist in each Tambon overall the agriculturists. This proportion would convert the amount of all agriculturists in each Tambon into the amount of sample cases in each Tambon. Thus, total sample size used in this study was 72. The number of target population and sample size in all 15 Tambons was showed in Table 3-2.

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Table 3-2 Number of target populations and sample size in the study area

Tambon	No. of target population	No. of sample size
1. Sampran	56	18
2. Bangchang	36	11
3. Banmai	34	11
4. Omyai	23	7
5. Bangkratuk	21	7
6. Klongjinda	18	6
7. Klongmai	12	4
8. Bangtoey	3	1
9. Raiking	3	1
10. Kratumlom	2	1
11. Yaicha	2	1
12. Taladjinda	1	1
13. Thongkanong	1	1
14. Takam	1	1
15. Tatalad	1	1
Total	214	72

3.4.5 Statistical Analysis

All collected data were checked for the completeness of the questionnaire. The data were divided into 2 parts including;

I) The orchid production technology of the study area.

II) The problems from the present orchid production technology.

All data were statistical analysed in percentage, mean and standard deviation.

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3.5 Determination of physical, chemical and biological characteristics of EM

The ingredient of 3 EM formulas in this research were described in Appendix D.

I) Formula A (Local formula) was obtained from Local Community Development Project, Community Organizations Development Institute (Public Organization) in Tambon Bangchang, Sampran District, Nakhonpathom Province.

II) Formula B (Government formula) was purchased from Thailand Institute of Scientific and Technological Research (TISTR).

III) Formula C (Commercial formula) was obtained from INS Enterprise SDN.BHD., Malaysia (INS Calibre Microorganism Bio-Fertilizer).

3.5.1 Determination of physical characteristics

The color and odor of EM samples were determined by observation. Total suspended solid (TSS) was analysed by dried weight measurement after dehydrated 25 mL of EM samples by hot air oven at 105°C for 1 hour (27).

3.5.2 Determination of chemical characteristics

The pH value of EM samples were measured by pH meter (27).

3.5.3 Determination of biological characteristics

The numbers of microorganism including fungi, bacteria and actinomycete were enumerated by standard plate count technique as described following: (28)

Step I: 10-fold serial dilution preparation (29)

I) For each EM sample, 0.1 mL of EM was pipetted into a 0.9 mL Tryptic Soy Broth (TSB) and shake well.

II) Before the suspension settled in the bottle, 0.1mL of the suspension was transferred with micropipette into a 0.9 mL TSB and then vortex well.

III) The next dilution was prepared same as the previous step and continue to final dilution at 10^{-6}.

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Step II: Spread plate technique

I) A 0.1 ml of each dilution including undilute, 10^{-2}, 10^{-4} and 10^{-6} was added to the surface of each type of cultural medium plate for isolation of bacteria, fungi and actinomycete (30). (Appendix E)

II) Immersed the bent glass-rod (spreader) into beaker containing absolute ethanol (over the bent portion) and pass it through the burner flame. Left the spreader to cool down for 15-20 seconds.

III) Removed partially the petri-dish cover and lightly touch the cooled-sterile bent glass-rod to the surface of the agar and move it back and forth, while slowly moved petri-dish in the clockwise and counter clockwise direction. This will spread the EM suspension over agar surface until the suspension on the surface of agar is uniform distribution.

IV) Close the petri-dish cover and immerse the spreader in alcohol and reflame.

V) Plates were incubated in an inverted position for 2 to 3 days at 30°C for fungi and bacteria and 1 week for actinomycete.

VI) After 2 days of incubation period, microbial colonies grow on the surface of agar plate.

3.6 Study of the efficiency of EM for the orchid cultivation

3.6.1 Experimental design

In the greenhouse scale, the experiment was designed by completely randomized design (CRD). The orchids in all treatments were cultivated followed by Good Agriculture Practice (GAP) method (10). This experiment was divided into 8 treatments and 10 replications in each treatment as described in Table 3-3. Each replication in all treatments was randomly placed in the greenhouse as shown in Table 3-4.

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Table 3-3 The treatment for the study of EM efficiency

Treatment	Method
1	Negative control (No Added)
2	Apply only chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20) as recommended by GAP method
3	Apply only EM formula A
4	Apply only EM formula B
5	Apply only EM formula C
6	Apply both EM formula A and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)
7	Apply both EM formula B and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)
8	Apply both EM formula C and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)

$N:P_2O_5:K_2O$ ratio : nitrogen:phosphorus:potassium ratio

Table 3-4 The position of the pots in each treatment in greenhouse

Treatment	Pot No.									
7	2	5	6	8	9	4	1	3	7	10
1	5	1	8	7	9	2	10	4	3	6
4	4	6	8	2	1	3	9	10	7	5
6	1	9	3	5	10	8	6	2	4	7
3	6	8	2	1	4	10	7	3	9	5
5	1	6	7	2	9	5	3	8	10	4
2	10	7	1	8	3	4	6	9	5	2
8	7	3	10	5	9	1	4	8	2	6

3.6.2 Orchid cultivation

The orchids (*Dendrobium* sp.) in this study were planted in greenhouse following GAP method (10) during July to October 2005 (rainy season).

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a) Orchid selection

One-year *Dendrobium* sp. cultivated by tissue culture technique were selected. These orchids were cut the bunch only 1 time. The orchids were planted in coconut fibrous and husk.

b) Greenhouse preparation

Greenhouse was built from wood and lined the roof with the black-colored net in order to reduce sunlight. These orchids were placed on tables made of lath-wood. The width and height of table were 100 and 40 cm; respectively. Between the tables, 1 m of sidewalk was provided.

c) Watering

Water was sprayed into the orchids in all treatments one a day during 06.00-09.00 am. The water was no spraying in rainy day.

d) Fertilization

Fertilizer (formula 20-20-20) was alternately daily added in the orchid at the concentration 500-700 g/water 200 L in one rai every week.

3.6.3 Determination of EM efficiency

The planted orchids in all treatments were observed as following items every 2 weeks of cultivation to 4 months in rainy season.

a) Productivity was measured from the number of orchid bunches and the number of new orchid bunches.

b) Quality was measured from the number of bloom flowers per bunch, the number of flowers per bunch, the diameter of the biggest flower in the bunch and the bunch length.

c) Plant disease protection was measured from the lesion on flower, bunch, leaf and stem of the orchid by counting the plants of each treatment that found the lesion.

3.6.4 Statistical analysis

The evaluation of determination of EM efficiency was calculated by rating scale which divided into 5 levels with score for each level as follows:

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Point	Score
≤ c	0
> c to (a-b)	1
> (a-b) to a	2
> a to (a+b)	3
> (a+b)	4

when a = Average of maximum
b = Standard deviation
c = Average of treatment 1 (Negative control)

3.7 Development of a guideline for *Dendrobium* sp. cultivation

The results of EM efficiency for *Dendrobium* sp. cultivation were summarized into the steps of *Dendrobium* sp. cultivation by biotechnology application as agriculturists' guideline.

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CHAPTER IV
RESULTS AND DISCUSSIONS

4.1 Survey of the orchid production technology in Sampran District, Nakhonpathom Province

4.1.1 Agriculturist's personal information

Personal characteristics of 72 agriculturists including of gender, age, educational level, experience in orchid cultivation, the number of labors who work in orchid farm, income, access information and knowledge related in agriculture attention in training, seminar, conference and meeting related in orchid cultivation were showed in Table 4-1 (Appendix F).

Table 4-1 Personal characteristics

Agriculturist's personal information	Percents (%)
1) Gender	
Male	72.22
Female	27.78
Total	100.00
2) Age (year)	
21 - 30	1.39
31 - 40	13.89
41 - 50	37.50
51 - 60	27.78
61 - 70	15.28
71 - 80	4.17
Total	100.00

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Table 4-1 Personal characteristics (Cont.)

Agriculturist's personal information	Percents (%)
3) Level of education	
No education	0.00
Primary school	66.67
Secondary school	20.83
Vocational education	4.17
Bachelor level or higher	8.33
Total	100.00
4) Experience in orchid cultivation	
4.1 Experience range (year)	
1 - 10	16.67
11 - 20	50.00
21 - 30	25.00
31 - 40	8.33
Total	100.00
4.2 Sources of experience	
Self-study	87.50
Local wisdom	12.50
Training	0.00
Total	100.00
5) Labors who work in orchid farm	
5.1 The number of labor (person)	
1 - 5	68.05
6 - 10	29.17
11 - 15	2.78
Total	100.00

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Table 4-1 Personal characteristics (Cont.)

Agriculturist's personal information	Percents (%)
5.2 Sources of labor	
Inside family	30.56
Outside family	8.33
Both items	61.11
Total	100.00
5.3 Number of labors inside family (person)	
1	22.73
2	57.57
3	10.61
4	7.57
5	1.52
Total	100.00
5.4 Number of labors outside family (person)	
1 - 5	90.00
6 - 10	8.00
11 - 15	2.00
Total	100.00
6) Income (bahts/month)	
1 - 10,000	15.28
10,001 - 20,000	43.05
20,001 - 30,000	15.28
30,001 - 40,000	8.33
40,001 - 50,000	12.50
50,001 - 60,000	0.00
60,001 - 70,000	1.39
70,001 - 80,000	2.78
80,001 - 90,000	0.00
90,001 - 100,000	1.39
Total	100.00

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Table 4-1 Personal characteristics (Cont.)

Agriculturist's personal information	Percents (%)
7) Access in formation concerning agricultural	
Talking with neighbour and member club	56.94
Government officer	19.45
Journal/Newspaper	11.11
Radio/Television	1.39
Other	11.11
Total	100.00
8) Training / Seminar / Conference and Meeting about orchid cultivation	
8.1 No participated	43.06
Participated	56.94
Total	100.00
8.2 Topics of training:	
- EM / Biofertilizer for orchid cultivation	7.32
- Thailand standard for orchids	17.07
- Plant pathogen / Plant pest of orchid	19.51
- Orchid cultivation follow by GAP method	26.83
- Chemical fertilizer and pesticide usage	29.27
Total	100.00
8.3 Training organization:	
- Pesticide company/Store	14.64
- Agricultural occupation development and promotion centre; Samutsakhon Province	17.07
- Tambon agricultural officer	19.51
- District agricultural officer	48.78
Total	100.00

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The population were male (72.22 %) and female (27.78 %). It was found that the majority agriculturists were male. The age of agriculturist was found that most of agriculturists age were 41 - 50 years old (37.50 %), 51 - 60 years old (27.78 %) and 21 - 29 years old (1.39 %). The maximum age was 75 years old and the minimum age was 29 years old. Agriculturists completed the primary school (66.67 %), the secondary school (20.83 %), Bachelor level or higher (8.33 %) and vocational education (4.17 %). To consider the worker experience in orchid cultivation, it was found that the average experience of agriculturist was 18.89 years. A half of agriculturists (50 %) had the experience in orchid cultivation around 11 - 20 years. 25.78 % of agriculturists have been worked in orchid farm around 21 - 30 years. The minor of agriculturists (8.33 %) have been worked in orchid farm for 31 - 40 years. The least experience of agriculturists was 2 years and the most experience of agriculturists was 40 years.

Moreover, this questionaire survey was found that most of agriculturists (87.50 %) have got the experience in orchid cultivation from their self study. Some agriculturists (12.50 %) got the experience from local wisdom. The labor in most farms (61.11 %) was both the member inside family and outside family. The maximum number of labors outside family was range between 11-15 persons. Most of labor inside family (57.57%) were 2 persons.

The average income was 24,079.86 bahts/month. The minimum income was 6,000 bahts/month and the maximum was 100,000 bahts/month. The majority of agriculturist (43.05 %) had income range in 10,001 - 20,000 bahts/month. The information related in agriculture was accessed through discussion with neighbour and member club, training by government officers (Tambon, District, Province agricultural officers and Agricultural Occupation Development and Promotion centre; Samutsakhon Province) and listening the radio. The survey showed that the majority access information from discussion with neighbour and member club was 58.33 %.

Around 56.94 % of all agriculturists used to participate in training, seminar, conference or meeting in the topic related in orchid cultivation. The chemical fertilizer and pesticide usage was the major topic of participation (29.27 %). The other topics of training, seminar, conference or meeting were orchid cultivation follow by GAP method, plant pathogen, plant pest of orchid, Thailand standard for orchids and

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EM and biofertilizer for orchid cultivation. Most of training courses were organized by District agricultural officer (48.78 %). A few training courses were conducted by Tambon agricultural officer, Agricultural Occupation Development and Promotion centre; Samutsakhon Province and pesticide company.

4.1.2 General information of orchid farm

The information from orchid farm in the information related to land characteristic and orchid cultivation was shown in Table 4-2.

Table 4-2 General information of orchid farm

General information of orchid farm	**Percents (%)**
1) Size of farm area (Rai)	
1 - 10	72.22
11 - 20	22.22
21 - 30	4.17
31 - 40	1.39
Total	100.00
2) Geographic location of farm	
Plain	79.17
Floodplain area	20.83
Total	100.00
3) Convenient to access in farm by ground transportation	100.00
4) Plain area and open space	100.00
5) Air flow pass through the farm	100.00
6) Orchids were placed on the table	100.00
7) Types of plantation materials	
Coconut fibrous and husk	100.00
8) Use water from river or canel	100.00

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Table 4-2 General information of orchid farm (Cont.)

General information of orchid farm	Percents (%)
9) The quality of water for orchid cultivation (Agriculturist opinion)	
Good	55.55
Medium	38.89
Poor	5.56
Total	100.00
10) The quantity of water for orchid cultivation	
Enough for orchid cultivation all over year	95.83
Not enough for orchid cultivation all over year	4.17
Total	100.00
11) The frequency of watering	
1 time / day	58.33
2 times / day	5.56
Alternative daily	31.94
1 time / 3-4 days	4.17
Total	100.00
12) The time of watering	
In the morning	77.78
At noon	0.00
In the evening	2.78
Both of morning and evening	2.78
Others	16.66
Total	100.00
13) Watering method	
Manual watering	41.67
Sprinkler system	44.44
Others	13.89
Total	100.00

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The results from Table 4-2 found that most of agiculturists in Sampran District, Nakhonpathom Province were small area (1-10 rais). All farms were easily to access by ground transportation and used water from river or canel for orchid cultivation. They constructed their own greenhouse for orchid cultivation by placing all orchid plants on the tables. Most of the farms used GAP method. Thus, the frequency of watering, duration of watering and watering method were the same in some farms.

4.1.3 Method for increasing and improving the quantity and quality of orchid production.

The information of chemical, fertilizer and other substances usage in orchid cultivation were surveyed from agriculturists at Sampran District, Nakhonpathom Province as shown in Table 4-3.

Table 4-3 Method for increasing and improving the quantity and quality of product

Method for increasing and improving the quantity and quality of product	**Percents (%)**
1) Method for increasing product quantity (Agriculturist practice)	
No adding any substance	11.11
Add chemical fertilizers	88.89
Total	100.00
2) Method for improving product quality (Agriculturist practice)	
No adding any substance	12.50
Add chemical fertilizers	87.50
Total	100.00

Generally, all farms were weekly applied inorganic fertilizers served as nutrients for orchid growth. The $N:P_2O_5:K_2O$ ratio of these inorganic fertilizers were 20:20:20, 21:21:21, 13:27:27 and 16:21:27.

The majority of agriculturists (88.89% and 87.50%) used some chemicals to increase both quantity and quality orchid production; respectively. The $N:P_2O_5:K_2O$ ratio of inorganic fertilizers were 10:52:17, 10:30:10, 10:52:10, 15:30:15 and 10:45:10 use for increasing orchid quantity. Fertilizer contained $N:P_2O_5:K_2O$ ratio

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6:24:30 and 16:21:27 used for lengthen orchid bunch. Formula 6:10:24 and 13:27:27 used for strengthen orchid bunch and formula 10:20:30 and 13:21:21 used for coloured flower of orchid. Fertilizer at the concentration 2.5-5 g/L were sprayed to orchid at weekly interval in one rai. Almost agriculturists thought that chemical fertilizer help to increase product quantity and quality in the short time and convenience for usage.

4.1.4 Method for plant diseases and plant pests protection and weeds control

Plant diseases, plant pests and weeds were seriously problems in orchid cultivation. There were several methods to control or eliminate these problems as shown in Table 4-4.

Table 4-4 Method for plant diseases and plant pests protection and weeds control

Method for plant diseases and plant pests protection and weeds control	**Percents (%)**
1) Plant diseases problem	100.00
2) Use chemical substances for plant diseases protection (Agriculturist practice)	100.00
3) Plant pests problem	100.00
4) Method for plant pests protection (Agriculturist practice)	
Natural control	0.00
Chemical substance usage	98.61
Others	1.39
Total	100.00
5) Weeds problem	100.00
6) Method for weeds control (Agriculturist practice)	
6.1 Weeds control on plantation material	
- Natural control	0.00
- Chemical substance usage	0.00
- Physical or mechanical removal	100.00
Total	100.00

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Table 4-4 Method for the plant diseases and plant pests protection and weeds control (Cont.)

Method for plant diseases and plant pests protection and weeds control	Percents (%)
6.2 Weeds control on ground (Agriculturist practice)	
- Natural control	0.00
- Chemical substance usage	77.78
- Physical or mechanical removal	22.22
Total	100.00

All farms confronted with plant diseases caused by many phytopathogens. The orchid diseases namely yellow leaf spot, flower rusty spot, leaf spot and black rot were found in different seasons. Normally, these plant diseases were controlled by chemical application. The main chemical substances used for plant diseases protection and control were Captan (0.5 g/L), Carbendazim (0.4 g/L), Mancozeb (2.5 g/L), Vitavax (0.2 g/L) and Tetradifon (0.4 g/L). Chemical substances were sprayed weekly interval in the morning period (06.00-09.00 am) (79.17%).

Orchid pests, thrips, orchid midge and worm, were found in different numbers depended on season variation. Orchid pests were eliminated by pesticide application (98.61%) and bioextract application such as neem seed extraction (1.39%). Pesticide used for orchid pest control were Carbosulfan (0.2 g/L), Cypermethrin (0.5 g/L), Abamectin (0.5 g/L), Chlorpyrifos (1 g/L) and Imidacloprid (0.5 g/L). The frequency and duration of pesticides application were similar to chemical substance application by making the combination of these substances.

Weeds were found in orchid green houses including grass (75%), lichen (13.89%) and ferns (11.11%). All weeds were eliminated from plantation material by physical or mechanical removal. However, most weeds grew under the orchid table were eliminated by weedicides application. Weedicides were Glyphosate-isopropyl ammonium (1 g/L) and Diuron 80 (0.3 g/L). Weedicides were weekly applied in the morning (06.00-09.00 am). There was no used weedicides on the plantation materials because these chemicals cause effect on orchid growth.

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4.1.5 Knowledge and usage of EM for the orchid cultivation

This study was focused on the application of EM on orchid cultivation. The knowledge of EM application was surveyed as shown in Table 4-5.

Table 4-5 Knowledge and usage of EM for the orchid cultivation

The knowledge and usage about EM	Percents (%)
1) About EM	
Never known EM	1.39
Known EM	98.61
Total	100.00
2) The first source of knowledge in EM	
Neighbour and member club	29.58
Government officer	
- Tambon agicultural officer	9.86
- District agicultural officer	32.39
- Agricultural Occupation Development and Promotion centre; Samutsakhon Province	4.23
Journal/Newspaper	0.00
Radio/Television	5.63
Others	18.31
Total	100.00
3) Access information in agriculture	
No	38.89
Yes	61.11
Total	100.00
4) Source of information	
Neighbour and member club	11.36
Government officer	81.82
Journal/Newspaper	0.00
Radio/Television	0.00
Others	6.82
Total	100.00

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Table 4-5 Knowledge and usage of EM for the orchid cultivation (Cont.)

The knowledge and usage about EM	Percents (%)
5) Used to use EM for orchid cultivation	
Use	58.33
Never use	41.67
Total	100.00
6) Use EM for orchid cultivation at present and reasons	
Yes	
- EM help to increase products and no any health effects on agriculturists	7.14
- EM help to increase products and reduce operation cost	2.38
- No reasons to support	7.14
No	
- Unconvenience for usage	16.67
- No any increase product quality and quantity	19.05
- Cause increasing the defoliation and fungi infection on orchid leaves and stems	9.52
- Quickly deterioration of plantation material	38.10
Total	100.00

From Table 4-5, almost agriculturists have known EM application. This information about EM was received from government officers (46.48%). However, a few agriculturists applied EM on their orchid farm (58.33%). Their main reasons for EM application were quickly plantation material deterioration.

4.2 Determination of physical, chemical and biological characteristics of EM

The results of physical, chemical and biological characteristics of 3 formulas of EM were shown in Table 4-6.

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Table 4-6 The physical, chemical and biological characteristics of EM

Characteristics	Formula A	Formula B	Formula C
Physical			
Color	Clear brown	Yellow	Green
Ordor	Fruit (banana)	Stench (fish)	Raw smell (leaf)
Total suspended solid (mg/L)	1.30×10^5	1.51×10^5	5.67×10^5
Chemical			
pH	3.78	8.55	3.80
Biological			
Fungi (CFU/mL)	1.91×10^3	ND	3.00×10^5
Bacteria (CFU/mL)	1.09×10^3	ND	5.00×10^5
Actinomycete (CFU/mL)	1.83×10^3	ND	1.16×10^3

ND : not determination

4.2.1 Physical characteristic

Based on Table 4-6, it was found that color and ordor of EM sample were different from each other. It depended on the ingredient of EM. Total suspended solid of EM formula C was the highest (5.67×10^5 mg/L) compared to other formulas because formula C contained high fiber of fresh leaves as the main ingredient. Total suspended solids of EM formula B and formula A were 1.51×10^5 and 1.30×10^5 mg/L; respectively.

4.2.2 Chemical characteristic

The pH of EM formula B (8.55) was higher than formula A (3.78) and formula C (3.80). From the result, it could be indicated that EM formula C and formula A were acidity but EM formula B was alkalinity due to its ingradient of fish-flesh and protein digestion process. In addition, EM formula B was adjusted pH to 6-6.5 with NaOH. Kultida and Amompan (31) reported that pH of EM (EM from EM Kyusei Co.,Ltd) was 3.47. The $N:P_2O_5:K_2O$ ratio of EM formula B was 5.7:0.4:2.4 (32).

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4.2.3 Biological characteristic

The result in Table 4-4 exhibited that the highest numbers of fungi ($3.00x10^5$ CFU/mL) and bacteria ($5.00x10^5$ CFU/mL) were found in EM formula C. Additionally, EM formula A contained the highest number of actinomycetes ($1.83x10^3$ CFU/mL). However, the number of fungi, bacteria and actinomycetes were not observed in EM formula B because EM formula B was prepared by strong acid adding.

4.3 Determination of EM efficiency

The determination of EM efficiency was investigated by greenhouse scale. Orchids in all treatments were cultivated followed by GAP method and divided into 8 treatments (10 replications in each treatment) as follows:

Table 4-7 The treatment for the study of EM efficiency

Treatment	Method
1	Negative control (No Added)
2	Apply only chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20) as recommended by GAP method
3	Apply only EM formula A
4	Apply only EM formula B
5	Apply only EM formula C
6	Apply both EM formula A and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)
7	Apply both EM formula B and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)
8	Apply both EM formula C and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)

All treatments were determined quantity and quality of orchid namely the number of orchid bunches, the bunch length, the number of flowers per bunch, the

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number of bloom flowers per bunch, the diameter of the biggest flower in the bunch and the lesion on flower, bunch, leaf and stem of the orchid.

4.3.1 Number of bloom flowers per bunch

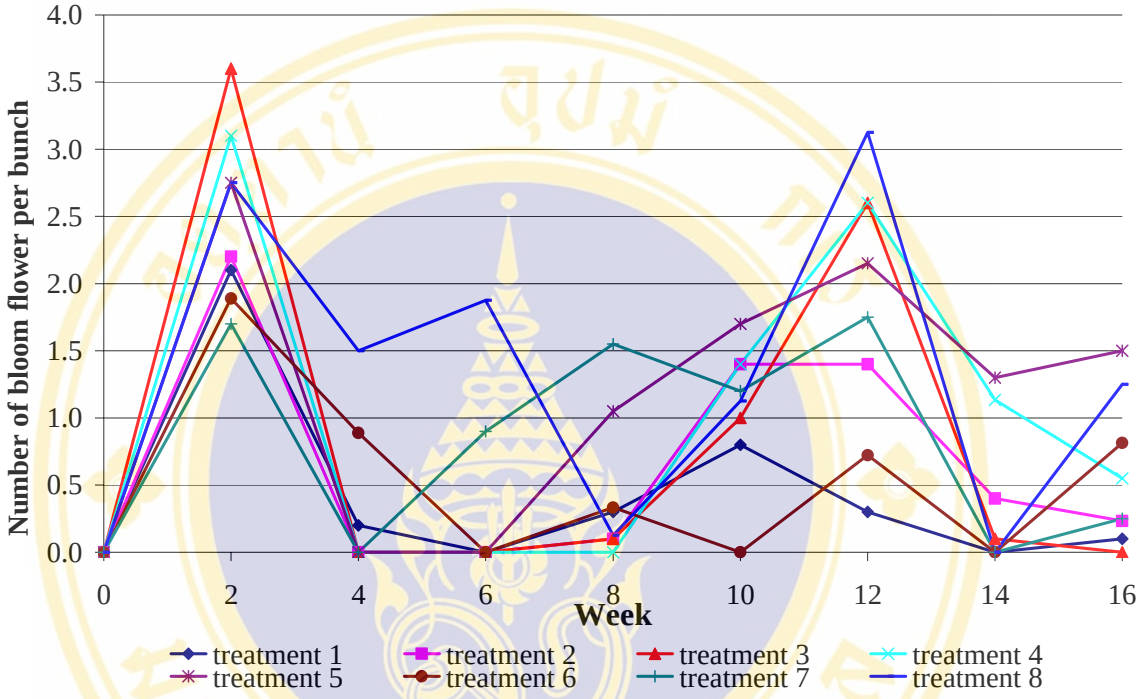

Figure 4-1 Number of bloom flowers per bunch

From Figure 4-1, it was found that the number of bloom flowers per bunch of treatment 3 was peaked at the 2nd week (3.60 bloom flowers per bunch). The number of bloom flowers per bunch of all treatments were the highest at the 2nd week, continuously decreased at the 4th week and sharply increased at the 12th week. This pattern showed the cycle of orchid production. The production cycle could be divided into 2 stages: production and resting stages. All treatments showed the same trend. However, the number of bloom flowers per bunch of all treatments were higher than treatment 1 (Negative control).

Moreover, the number of bloom flowers per bunch of treatment 3 was the highest but the number of bloom flowers per bunch of treatment 8 was more consistent blooming than treatment 3. From this result, it means that the treatment 8 was proper for increasing flower productivity.

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4.3.2 Number of flowers per bunch

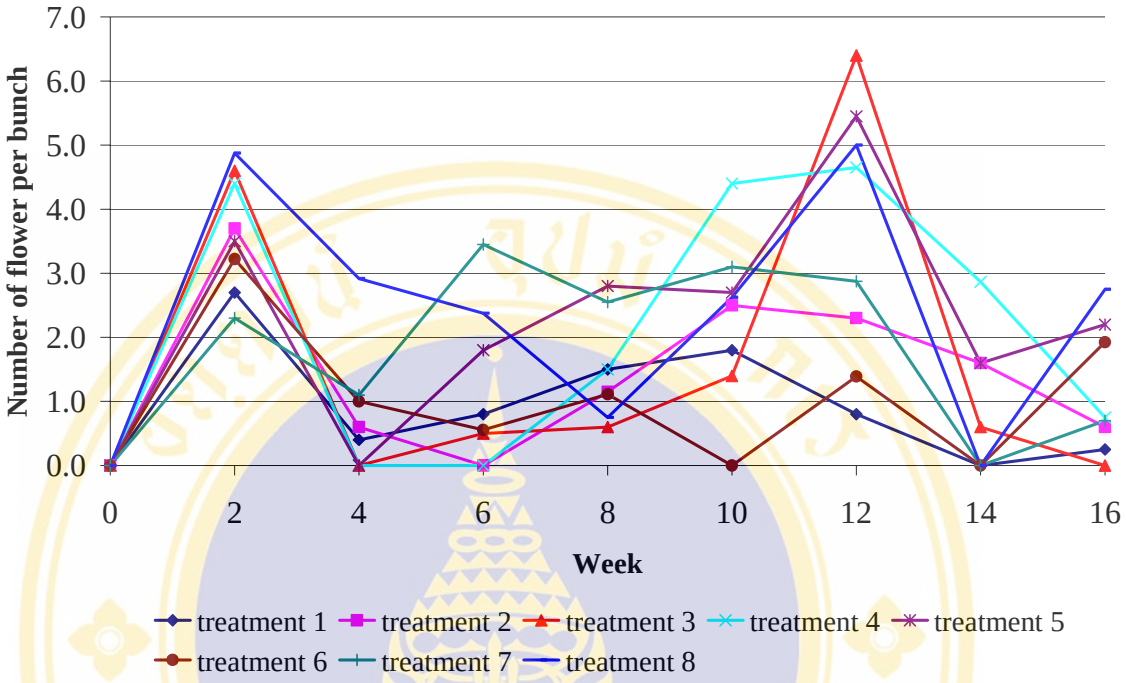

Figure 4-2 Number of flowers per bunch

The number of flowers per bunch of treatment 3 was the highest at the 12th week (6.40 flowers per bunch). The number of flowers per bunch of all treatments were peaked at 2nd week, continuously decreased and suddenly increased at the 12th week. Trend of number of flowers per bunch in every treatments was similar.

The number of flowers per bunch of every treatments was higher than treatment 1 (Negative control) but the most efficiency treatment for flower productivity was treatment 3.

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4.3.3 Diameter of the biggest flower in the bunch

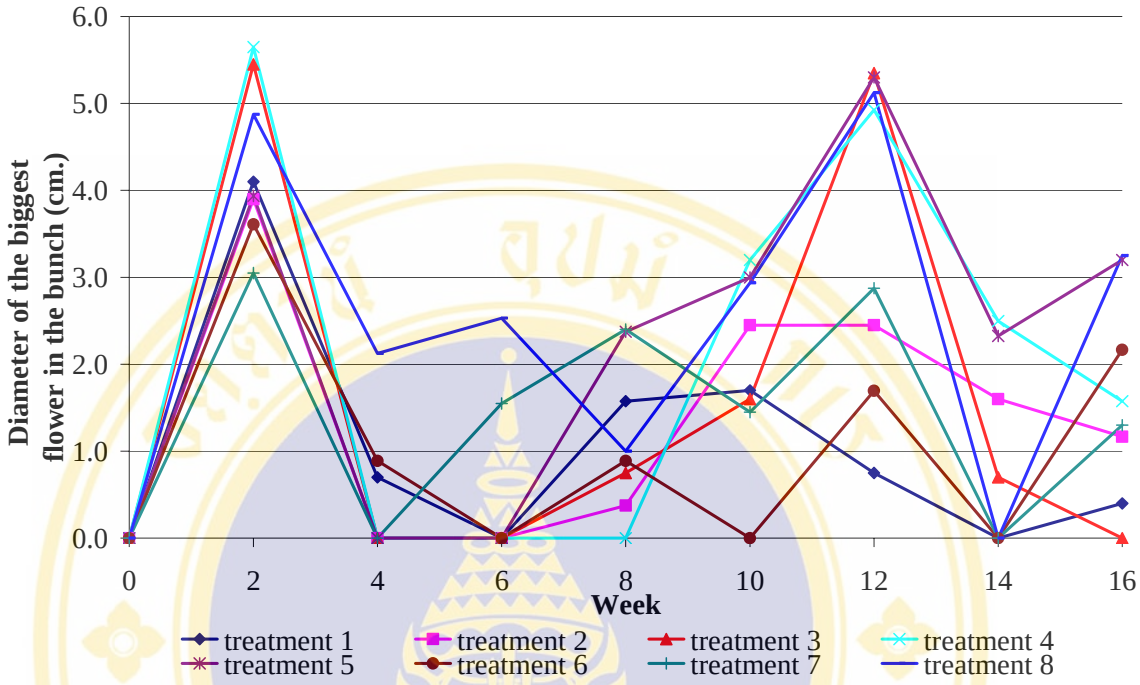

Figure 4-3 Diameter of the biggest flower in the bunch

The diameter of the biggest flower in the bunch was found in treatment 4 at the 2nd week (5.65 cm.). However, the diameter of the biggest flower in the bunch of treatments 4 and 3 were nearly similar.

This result revealed that treatment 3, 4, 5 and 8 exhibited the higher diameter of the biggest than treatment 1, 2, 6 and 7.

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4.3.4 Number of orchid bunches

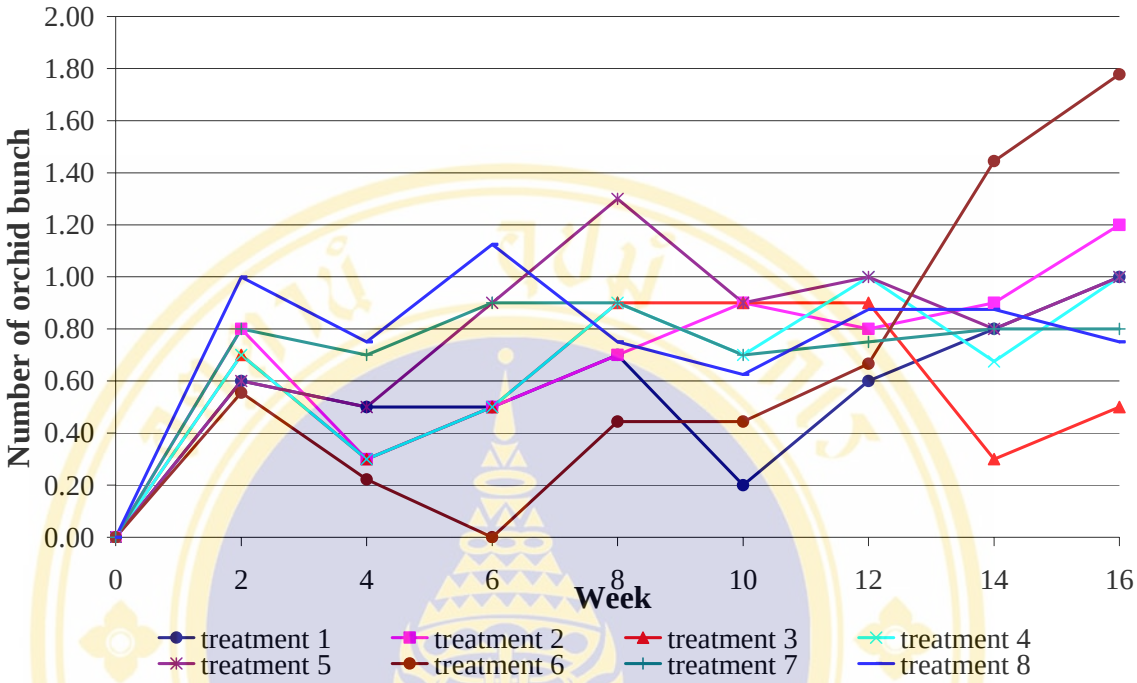

Figure 4-4 Number of orchid bunches

From Figure 4-4, it was found that the number of orchid bunches in all treatments were nearly the same. However, the number of orchid bunches of treatment 6 was sharply increased at the 14th week and peaked at the 16th week (1.78 bunch). It could be indicated that treatment 6 showed high efficiency for bunch production.

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4.3.5 Number of new orchid bunches

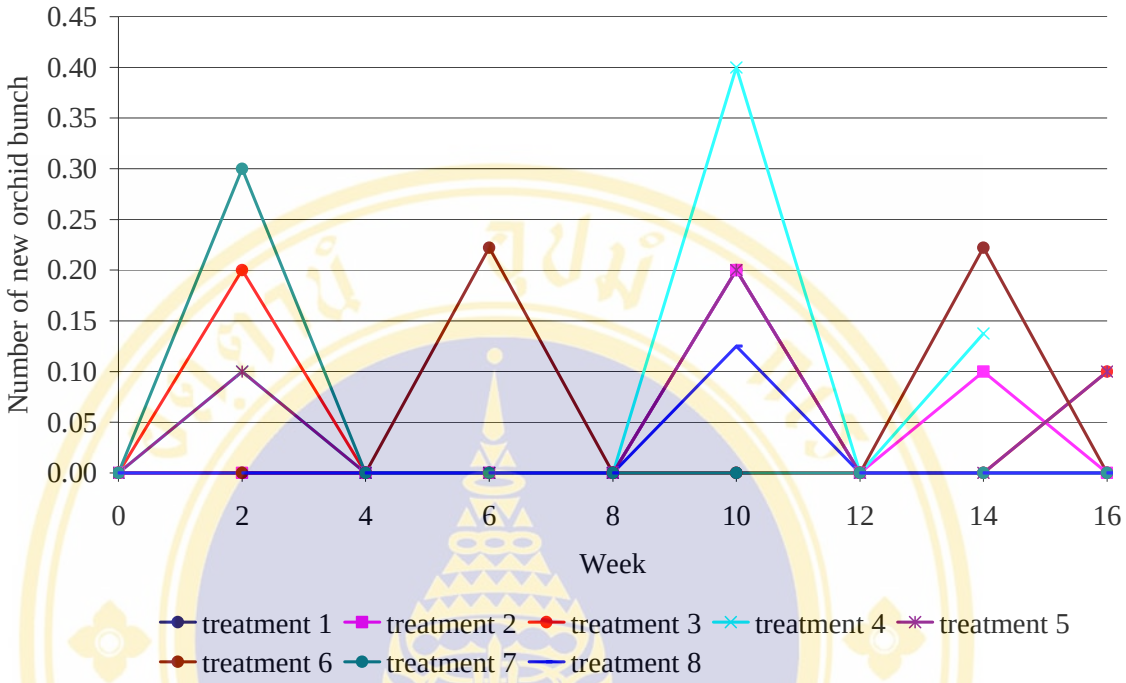

Figure 4-5 Number of new orchid bunches

From Figure 4-5, it could be divided into 2 groups including: I) Treatment 1, 5 and 7 were not increase in number of orchid bunches II) In treatment 2, 3, 4, 6 and 8, the trend of the number of new orchid bunches of all treatments were the same. The highest number of new orchid bunches was 0.40 bunch that found in treatment 4 at the 10^{th} week.

Treatment 6 provided more consistency in the number of orchid bunches than other treatments in all observed time (4 months). Thus, treatment 6 could induce high efficiency for new bunch production.

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4.3.6 Bunch length

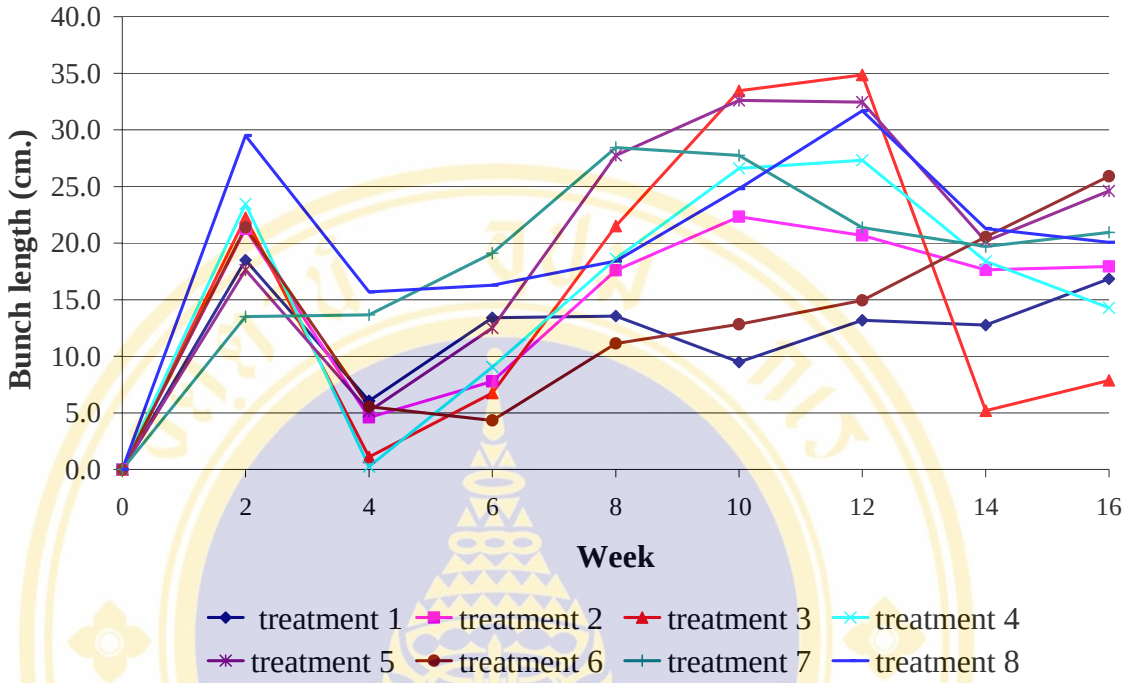

Figure 4-6 Bunch length of orchid

From Figure 4-6, the bunch length of treatment 3 was peaked at the 12th week (34.85 cm.). However, the bunch length of the treatment 3 at the 10th and 12th week were nearly same as the treatment .

4.3.7 Number of disease lesion on flower, bunch, leaf and stem of the orchid

The disease lesion on flower, bunch, leaf and stem of the orchid were determined by counting the plants of each treatment. The result was described in Table 4-8.

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Table 4-8 Number of plants that found the lesion

Treatment	No. of plants that found the lesion								Total
	2nd week	4th week	6th week	8th week	10th week	12th week	14th week	16th week	
1	2	2	2	2	3	2	3	3	19
2	4	3	3	4	4	3	2	3	26
3	0	0	0	2	2	2	1	1	8
4	0	0	0	1	2	4	4	2	13
5	0	0	0	0	1	0	0	1	2
6	0	1	1	4	4	3	3	3	19
7	0	0	0	0	2	3	2	3	10
8	1	2	1	1	3	3	2	2	15

From Table 4-8, the least number of plants got lesion was found in treatment 5 (2 plants). Treatment 2 showed the highest number of plant got lesion (26 plants). Treatment 3 (apply only EM formula A) and 5 (apply only EM formula C) showed the less number of plants that found the lesion than the treatment 6 and 8 that applied both EM and chemical fertilizer and treatment 2 that applied fertilizer. In contrast, the number of plants got the lesion of treatment 4 (apply only EM formula B) was higher than that of treatment 7 (apply both EM formula B and chemical fertilizer).

Many factors involved in pathogen infection in orchid such as virulent of pathogen, environmental condition, plant defense responses. EI-Tarabily et al. (33) reported that some microbes play a potential role as antagonistic activity against phytopathogen. One of the mechanisms of antagonistic activity was chitinase enzyme production. EM could protect the orchid from plant disease. Twenty-three bacteria and 38 streptomycete and 15 nonstreptomycete actinomycete isolates produced high levels of chitinase. The three isolates, *Serratia marcescens, Streptomyces viridodiasticus* and *Micromonospora carbonacea*, significantly reduced the growth of *Sclerotinia minor*, a pathogen causing basal drop disease of lettuce, and produced high levels of chitinase and β-1,3-glucanase. *S. viridodiasticus* also produced antifungal metabolite(s) that significantly reduced the growth of the pathogen *in vitro*. All three isolates, individually or incombination, were antagonistic to *S. minor* and significantly reduced

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incidence of disease under controlled glasshouse conditions (33). In addition, Makoto Shoda (34) found that *Pseudomonas* strains are one of the most active and dominant bacteria in the rhizospere and have been intensively investigated as biocontrol agents. The biocontrol potential of *Pseudomonas* strains was confirmed by the study of Dowling and O' Gara (35). Their study revealed that *Pseudomonas* produced several kinds of antibiotics, such as pyrolnitrin, pyoluteorin and phenezine-1-carboxylate, all of which are closely related to the substances that can suppress plant diseases. The study by Kiewnick and Sikora (36) showed that the fungal biocontrol agent, *Paecilomyces lilacinus* strain 251, was evaluated for its potential to control the root-knot nematode *Meloidogyne incognita* on tomato.

Moreover, treatments 3 and 5 had no chemical fertilizer application. It was indicated that the chemical fertilizer was less effective to protect orchid diseases than EM. The evaluation of EM efficiency in the improvement of quantity and quality of orchid production and disease protection was determined by rating scale into 5 levels. The rating scale of each parameter and the score of each treatment were shown in Table G-1 and Table G-2; respectively (Appendix G). The score of each treatment was summaried in Table 4-9 and the ascending order of score was shown in Table 4-10.

Table 4-9 The score of all treatments

Treatment	Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)	Total
1	4	4	6	3	4	6	**27**
2	7	9	9	5	10	12	**52**
3	8	8	9	5	7	11	**48**
4	10	10	10	8	8	11	**57**
5	14	14	15	7	12	15	**77**

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Table 4-9 The score of all treatments (Cont.)

Treatment	Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)	Total
6	5	5	7	6	8	7	**38**
7	9	11	9	4	10	16	**59**
8	15	14	15	2	12	16	**74**

Table 4-10 Ascending order of all treatments

Order	Score	treatment	Treatment
1	77	5	apply only EM formula C
2	74	8	apply both EM formula C and chemical fertilizer
3	59	7	apply both EM formula B and chemical fertilizer
4	57	4	apply only EM formula B
5	52	2	apply only chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)
6	48	3	apply only EM formula A
7	38	6	apply both EM formula A and chemical fertilizer
8	27	1	Negative control (No added)

The results in Table 4-10 showed that treatment 5 (apply only EM formula C) exhibited the highest efficiency in orchid cultivation. This treatment provided the highest score. In addition, there was no effect of chemical fertilizer on orchid production when applied both EM formula C and chemical fertilizer (treatment 8). This observation was confirmed in treatment 4 (apply only EM formula B) and treatment 7 (apply both EM formula B and chemical fertilizer). The scores of treatment 4 and 7 were slightly different.

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This result could be indicated that EM formula C has the potential to enhance the quantity and quality of orchid production and disease protection. EM formula C contained the high number of microorganisms both bacteria and fungi. It has been reported that mycorrhizal fungi serve as biofertilizers, reduce plant stress, and can increase plant productivity. The predominant arbuscular mycorrhiza genera at the site were *Gigaspora*, *Glomus* and *Scutellosporas* (37). Additionally, rhizosphere bacteria influence plant growth through several mechanisms. Major beneficial activities of soil bacteria include solubilization of minerals, fixation of nitrogen, production of growth-promoting hormones and competitive suppression of pathogens (38).

4.4 Development of a guideline for *Dendrobium* sp. cultivation

The results of EM efficiency for *Dendrobium* sp. cultivation were summarized into the steps of *Dendrobium* sp. cultivation by biotechnology application as agriculturists' guideline in following steps:

Step 1: Greenhouse preparation

Greenhouse was prepared follow by GAP method (10) that was built from wood and lined the roof with the black-colored net in order to reduce sunlight. These orchids were placed on tables made of lath-wood. The width and height of table were 100 and 40 cm.; respectively. Between the tables, 1 m. of sidewalk was provided.

Step 2: Orchid cultivation

Dendrobium sp. from tissue culture were planted in coconut fibrous and husk.

Step 3: Watering

The water was daily sprayed to the orchids by manual method or sprinkle system in the morning period (06.00-09.00 am). However, the water was not spraying in rainy day.

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Step 4: Fertilization and EM usage

Fertilizers (formula 20-20-20 or 21-21-21) were weekly applied at the concentration 5 g/L in one rai (06.00-09.00 am). EM formula C was sprayed at the concentration 1.5 mL/L at 2-week interval

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CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The conclusion of this research can be divided into 4 parts as follows:

5.1.1 Survey the orchid production technology in Sampran District, Nakhonpathom Province

This part was focused on the processes of orchid cultivation in Sampran District, Nakhonpathom Province. The target population of this research consisted of agriculturists who cultivated *Dendrobium* sp. in study area and their names were in the list of orchid exportor in year 2000. The sample size was 72 that determined by Taro Yamane (26) and the statistic analysis was performed base on a 90% confidence interval (C.I.).

The results showed that the majority of agriculturists accessed the agricultural information through discussion with neighbour and member club. Around 56.94 % of all agriculturists used to participate in training, seminar, conference or meeting in the topic related in orchid cultivation. The chemical fertilizer and pesticide usage was the major topic of participation (29.27%). The other topics were orchid cultivation follow by GAP method, plant pathogen, plant pest of orchid, Thailand standard for orchids and EM and biofertilizer for orchid cultivation. Most of training courses were organized by District agricultural officer (48.78%). A few training courses were conducted by Tambon agricultural officer, Agricultural Occupation Development and Promotion centre; Samutsakhon Province and pesticide company.

Moreover, this questionnaire survey was found that most of the farms in Sampran District, Nakhonpathom Province were small area (1-10 rais). Generally, all farms were weekly applied inorganic fertilizers served as nutrients for orchid growth. The $N:P_2O_5:K_2O$ ratio of these inorganic fertilizers were 20:20:20, 21:21:21, 13:27:27 and 16:21:27.

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The majority of agriculturists used some chemicals to increase both quantity and quality orchid production; respectively. The $N:P_2O_5:K_2O$ ratio of inorganic fertilizers were 10:52:17, 10:30:10, 10:52:10, 15:30:15 and 10:45:10 use for increasing orchid quantity. Fertilizer contained $N:P_2O_5:K_2O$ ratio 6:24:30 and 16:21:27 used for lengthen orchid bunch. Formula 6:10:24 and 13:27:27 used for strengthen orchid bunch and formula 10:20:30 and 13:21:21 used for colored flower of orchid. Almost agriculturists thought that chemical fertilizer help to increase product quantity and quality in the short time and convenience for usage.

All farms confronted with plant diseases caused by many phytopathogens. The orchid diseases namely yellow leaf spot, flower rusty spot, leaf spot and black rot were that found different in each season. These diseases were controlled by chemical application. The main chemical substances were Captan, Carbendazim, Mancozeb, Vitavax and Tetradifon.

Orchid pests, thrips, orchid midge and worm were found in different numbers depended on season variation. Orchid pests were eliminated by pesticide application and bioextract application such as neem seed extraction. Pesticide used for orchid pest control were Carbosulfan, Cypermethrin, Abamectin, Chlorpyrifos and Imidacloprid. The frequency and duration of pesticides application were as same as chemical substance application due to make combination of these substances.

Weeds were found in orchid greenhouses including grass, lichen and ferns. All weeds were eliminated from plantation material by physical or mechanical removal. However, most weeds grew under the orchid table were eliminated by weedicides application. Weedicides were Glyphosate-isopropyl ammonium and Diuron 80. There was no used weedicides on the plantation materials because these chemicals cause effect on orchid growth.

The last, almost agriculturists have known EM application. The most of information was received from government officers. However, a few agriculturists applied EM on their orchid farm. Their main reasons for EM application were quickly plantation material deterioration.

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5.1.2 Determination of physical, chemical and biological characteristics of EM

EM sample of this study were 3 formulas (local formula, government formula and commercial formula) that had the different ingredient. From the result, it was found that color and ordor of EM sample were different each other. It depended on the ingredient of EM. Total suspended solid of EM formula C was the highest ($5.67x10^5$ mg/L) compared to other formulas because formula C contained high fiber of fresh leaves as the main ingredient. EM formula C and formula A were acidity but EM formula B was alkalinity due to its ingradients of fish-flesh and protein digestion process. The highest numbers of fungi and bacteria were found in EM formula C. Additionally, EM formula A contained the highest number of actinomycetes. However, the number of fungi, bacteria and actinomycetes were not observed in EM formula B because EM formula B was prepared by strong acid adding.

5.1.3 Study of the efficiency of EM for the orchid cultivation

The determination of EM efficiency was investigated by greenhouse scale. Orchids in all treatments were cultivated followed by GAP method and divided into 8 treatments (10 replications in each treatment). All treatments were determined quantity and quality of orchid namely the number of orchid bunches, the bunch length, the number of flowers per bunch, the number of bloom flowers per bunch, the diameter of the biggest flower in the bunch and the lesion on flower, bunch, leaf and stem of the orchid. The disease lesions on flower, bunch, leaf and stem of the orchid were determined by counting the plants in each treatment.

From the result, it was indicated that the chemical fertilizer was less effective to protect orchid diseases than EM. The evaluation EM efficiency in the improvement of quantity and quality of orchid production and disease protection was determined by rating scale in 5 levels. It found that treatment 5 (apply only EM formula C) exhibited the highest efficiency in orchid cultivation. In addition, there was no effect of chemical fertilizer on orchid production. The scores of treatment 5 (apply only EM formula C) and treatment 8 (Apply both EM formula C and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)) were nearly same. This observation was confirmed in treatment 4 (apply only EM formula B) and treatment 7 (Apply both EM formula B

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and chemical fertilizer ($N:P_2O_5:K_2O$ ratio is 20:20:20)). The scores of treatment 4 and 7 were slightly different.

This result could be indicated that EM formula C has the potential to enhance the quantity and quality of orchid production and disease protection. EM formula C contained the high number of microorganisms both bacteria and fungi.

5.1.4 Development of a guideline for *Dendrobium* sp. cultivation

The results of EM efficiency for *Dendrobium* sp. cultivation were summarized into the steps of *Dendrobium* sp. cultivation by biotechnology application as farmers' guideline in following steps:

Step 1: Greenhouse preparation

Greenhouse was prepared follow by GAP method (10) that was built from wood and lined the roof with the black-colored net in order to reduce of sunlight. These orchids were placed on tables mode from lath-wood. The width and height of table were 100 and 40 cm.; respectively. Between the tables, 1 m. of sidewalk was provided.

Step 2: Orchid cultivation

Dendrobium sp. was cultivated by tissue culture technique and using of coconut fibrous and husk as growth media.

Step 3: Watering

The water was daily sprayed to the orchids by manual method or sprinkle system in the morning period (06.00-09.00 am). However, the water was no spraying in rainy day.

Step 4: Fertilization and EM usage

Fertilizers (formula 20-20-20 or 21-21-21) were weekly applied by fertigation at the concentration 5 g/L in one rai (06.00-09.00 am). EM formula C was sprayed at the concentration 1.5 mL/L at 2-week interval

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5.2 Recommendation

5.2.1 In this study, the sample size was determined by Taro Yamane equation that performed base on a 90% confidence interval (C.I.) because this study was done on the time limitation. The future study should be performed base on 95% C.I. or more than 95% C.I. for the increased accuracy of result.

5.2.2 The quantity of EM formula should be increased in order to expand the varities of types of microorganisms.

5.2.3 From determination of biological characteristics, the numbers of microorganism including bacteria, actinomycetes and fungi were counted. So, the specific genus and species should be identified.

5.2.4 The lesion formation should be counted the number of lesion on each orchid plant and lesion severity should be rating by specific determined rating scale.

5.2.5 In the greenhouse scale of this experiment, the orchid was divided into 8 treatments and 10 replications in each treatment. For more accuracy of result, the experiment should be set the replication more than 10 replications.

5.2.6 In this study, the planted orchid was observed for 4 monthes (rainy season) cause of the limited study time. The future study should be observed more than 4 months and cover all seasons because some parameters such as plant disease protection could show the clearly results in a long time.

5.2.7 A guideline for orchid cultivation should be transferred to agriculturists by Agricultural Promoting Authority, Ministry of Agriculture and Cooperatives in appropriated methods such as conferences, meeting or direct consultation.

5.2.8 The process in orchid cultivation should be considered in the expenses of chemical fertilizer and pesticide compared to that of EM application.

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APPENDIX

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APPENDIX A
THAILAND STANDARD FOR ORCHIDS

มาตรฐานสินค้าเกษตรและอาหารแห่งชาติ

มกอช. 5000 – 2547

THAI AGRICULTURAL COMMODITY AND FOOD STANDARD

TACFS 5000 – 2004

กล้วยไม้

ORCHIDS

สำนักงานมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ
กระทรวงเกษตรและสหกรณ์

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โทรศัพท์ 0 2281 5955 www.acfs.go.th

ประกาศในราชกิจจานุเบกษา ฉบับประกาศทั่วไป เล่ม 121 ตอนพิเศษ 63 ง
วันที่ 7 มิถุนายน พุทธศักราช 2547

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คณะทำงานร่างมาตรฐานกล้วยไม้ หน้าวัว ปทุมมา กุหลาบ มะลิ เบญจมาศ

1. ประธานคณะทำงาน
   นายโอฬาร พิทักษ์ (ผู้อำนวยการสำนักส่งเสริมและจัดการสินค้าเกษตร กรมส่งเสริมการเกษตร)
2. ผู้แทนกรมการค้าต่างประเทศ
3. ผู้แทนกรมการค้าภายใน
4. ผู้แทนกรมส่งเสริมการส่งออก
   นางสาวนลินี โหมาศวิน
5. ผู้แทนกรมส่งเสริมสหกรณ์
6. ผู้แทนสำนักงานเศรษฐกิจการเกษตร
   นายสมบัติ ห.พากเพียร
   นางสาวศิริวรรณ ประเศรษฐานนท์
7. ผู้แทนสถาบันวิจัยพืชสวน กรมวิชาการเกษตร
   นายนิยมรัฐ ไตรศรี
   นางจงวัฒนา พุ่มหิรัญ
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   นางปิยรัตน์ เขียนมีสุข
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   นายสมเกียรติ ขำเอี่ยม
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    นางบุษรา จันทร์แก้วมณี
11. ผู้แทนสำนักพัฒนาคุณภาพสินค้าเกษตร กรมส่งเสริมการเกษตร
    นางวารี เจริญผล
12. ผู้แทนสำนักงานมาตรฐานสินค้าและระบบคุณภาพ สำนักงานมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ
    นางอรทัย ศิลปนภาพร
13. ผู้แทนสำนักส่งเสริมและจัดการสินค้าเกษตร กรมส่งเสริมการเกษตร
    นายทวีพงศ์ สุวรรณโร
14. ผู้แทนคณะเกษตร มหาวิทยาลัยเกษตรศาสตร์
    ผศ. สุรวิช วรรณไกรโรจน์
15. ผู้ทรงคุณวุฒิ

นางอรนุช กองกาญจนะ	ข้าราชการบำนาญ ผู้เชี่ยวชาญด้านการอารักขาพืช
นายเอนก ชัยอภิชิตไพบูลย์	ผู้แทนสมาคมผู้ส่งออกดอกกล้วยไม้
นายเจตน์ มีญาณเยี่ยม	ผู้แทนไทยออร์คิด จำกัด
นายสุวิทชัย แสงเทียน	ประธานกลุ่มผู้ปลูกเลี้ยงกล้วยไม้ราชบุรี

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17. สำนักงานมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ
    นางเสาวณีย์ อภิญญานุวัฒน์ คณะทำงานและผู้ช่วยเลขานุการ
18. ผู้แทนกรมวิชาการเกษตร คณะทำงานและผู้ช่วยเลขานุการ

กล้วยไม้เป็นไม้ดอกที่ประเทศไทยเป็นประเทศผู้ผลิตและส่งออกที่สำคัญของโลก ดังนั้นเพื่อให้กล้วยไม้ของไทยเป็นที่ยอมรับในระดับชาติและระดับสากล เพื่อให้คุณภาพเป็นที่ยอมรับของผู้บริโภค และส่งเสริมการส่งออก กระทรวงเกษตรและสหกรณ์จึงเห็นสมควรจัดทำมาตรฐานกล้วยไม้ขึ้น

มาตรฐานนี้กำหนดขึ้นโดยอาศัยข้อมูลจากเอกสารต่อไปนี้เป็นแนวทาง

ประกาศกระทรวงเกษตรและสหกรณ์ เรื่อง มาตรฐานกล้วยไม้ของประเทศไทย พ.ศ. 2541

กรมวิชาการเกษตร. 2545 . เกษตรดีที่เหมาะสมสำหรับกล้วยไม้ตัดดอก. โรงพิมพ์ชุมนุมสหกรณ์การเกษตรแห่งประเทศไทย, กรุงเทพฯ. 22 หน้า.

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เรื่อง กำหนดมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ : กล้วยไม้
พ.ศ. 2547

โดยที่เป็นการสมควรกำหนดมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ เรื่อง กล้วยไม้ เพื่อเป็นประโยชน์ต่อการปรับปรุงคุณภาพ การอำนวยความสะดวกทางการค้า และการคุ้มครองผู้บริโภค ดังนั้น คณะกรรมการมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ จึงออกประกาศกำหนดมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ เรื่อง กล้วยไม้ ไว้ใช้เป็นมาตรฐานสมัครใจ ดังมีรายละเอียดแนบท้ายประกาศนี้

ประกาศ ณ วันที่ ๒๖ เมษายน พ.ศ. 2547

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ประธานคณะกรรมการมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ

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มาตรฐานสินค้าเกษตรและอาหารแห่งชาติ

กล้วยไม้

1 นิยามของผลิตผล

มาตรฐานนี้ใช้กับ กล้วยไม้ (Orchid) ซึ่งเป็นพืชอยู่ในวงศ์ Orchidaceae 5 สกุล ที่ผลิตเป็นกล้วยไม้สดตัดดอกเพื่อการค้า คือ

1.1 สกุลหวาย (*Dendrobium* spp.)

1.2 สกุลออนซิเดียม (*Oncidium* spp.)

1.3 สกุลอะแรนดา (*Aranda* spp.)

1.4 สกุลมอคคารา (*Mokara* spp.)

1.5 สกุลแวนดา (*Vanda* spp.)

2 ข้อกำหนดเรื่องคุณภาพ

2.1 คุณภาพขั้นต่ำ

2.1.1 กล้วยไม้ทุกชั้นมาตรฐานต้องมีคุณภาพ ดังต่อไปนี้ เว้นแต่จะมีข้อกำหนดเฉพาะของแต่ละชั้น และเกณฑ์ความคลาดเคลื่อนที่ยอมให้มีได้ตามที่ระบุไว้ คือ

2.1.1.1 สด สะอาด

2.1.1.2 ไม่มีรอยตำหนิเด่นชัด

2.1.1.3 ก้านช่อดอกแข็งแรง

2.1.1.4 ไม่พบศัตรูพืช

2.1.2 กล้วยไม้ต้องเก็บในระยะเวลาที่เหมาะสม ผ่านกระบวนการเก็บเกี่ยวและการดูแลหลังการเก็บเกี่ยวด้วยความระมัดระวัง การบรรจุหีบห่ออยู่ในสภาพที่ยอมรับได้เมื่อถึงปลายทาง

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2.2 การแบ่งชั้นคุณภาพ

กล้วยไม้ตามมาตรฐานนี้ แบ่งเป็น 3 ชั้นคุณภาพ ดังนี้

2.2.1 ชั้นพิเศษ ("Extra" class)

กล้วยไม้ในชั้นนี้ต้องมีคุณภาพดีที่สุด ไม่มีดอกร่วง ปลอดจากศัตรูพืช ดอกไม่มีรอยตำหนิ และความเสียหายอันเนื่องมาจากศัตรูพืช

2.2.2 ชั้นหนึ่ง (Class I)

กล้วยไม้ในชั้นนี้ต้องมีคุณภาพดี ไม่พบศัตรูพืช ดอกมีตำหนิได้เล็กน้อย โดยไม่มีผลต่อคุณภาพ คุณภาพการเก็บรักษา รวมถึงการจัดเรียงเสนอในภาชนะบรรจุ

2.2.3 ชั้นสอง (Class II)

กล้วยไม้ในชั้นนี้ไม่เข้าชั้นคุณภาพที่สูงกว่า แต่มีคุณภาพขั้นต่ำเป็นไปตามข้อ 2.1 และไม่รวมดอกกล้วยไม้ที่มีรอยตำหนิเด่นชัด ซึ่งมีผลต่อคุณภาพ คุณภาพการเก็บรักษา รวมถึงการจัดเรียงเสนอในภาชนะบรรจุ

3 ข้อกำหนดเรื่องขนาด

ขนาดของกล้วยไม้แต่ละสกุลพิจารณาจากความยาวช่อดอก จำนวนดอกและจำนวนดอกบานต่อช่อ โดยต้องเป็นไปตามข้อกำหนดในตารางที่ 1- 4 ดังนี้

ตารางที่ 1 ขนาดกล้วยไม้สกุลหวาย แบ่งเป็น 4 ขนาด คือ

	ช่อยาวพิเศษ	ช่อยาว	ช่อสั้น	ช่อสั้นสุด
ความยาวช่อดอก	ไม่น้อยกว่า 55 เซนติเมตร	ไม่น้อยกว่า 45 เซนติเมตร	ไม่น้อยกว่า 35 เซนติเมตร	ไม่น้อยกว่า 30 เซนติเมตร
จำนวนดอก/ช่อ	ไม่น้อยกว่า 12 ดอก	ไม่น้อยกว่า 10 ดอก	ไม่น้อยกว่า 8 ดอก	ไม่น้อยกว่า 6 ดอก
จำนวนดอกบาน/ช่อ	ไม่น้อยกว่า 7 ดอก	ไม่น้อยกว่า 6 ดอก	ไม่น้อยกว่า 5 ดอก	ไม่น้อยกว่า 4 ดอก

ตารางที่ 2 ขนาดกล้วยไม้สกุลออนซิเดียม แบ่งเป็น 3 ขนาด คือ

	ช่อยาวพิเศษ	ช่อยาว	ช่อสั้น
ความยาวช่อดอก	ไม่น้อยกว่า 70 เซนติเมตร	ไม่น้อยกว่า 50 เซนติเมตร	ไม่น้อยกว่า 40 เซนติเมตร
จำนวนดอกบาน/ช่อ	ไม่น้อยกว่า 2 ใน 5 ของจำนวนดอก		

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ตารางที่ 3 ขนาดกล้วยไม้สกุลอะแรนดาและมอคคารา แบ่งเป็น 3 ขนาด คือ

	ช่อยาวพิเศษ	ช่อยาว	ช่อสั้น
ความยาวช่อดอก	ไม่น้อยกว่า 50 เซนติเมตร	ไม่น้อยกว่า 40 เซนติเมตร	ไม่น้อยกว่า 30 เซนติเมตร
จำนวนดอกบาน/ช่อ	ไม่น้อยกว่า 4 ใน 5 ของจำนวนดอก		

ตารางที่ 4 ขนาดกล้วยไม้สกุลแวนดา แบ่งเป็น 3 ขนาด คือ

	ช่อยาวพิเศษ	ช่อยาว	ช่อสั้น
ความยาวช่อดอก	ไม่น้อยกว่า 50 เซนติเมตร	ไม่น้อยกว่า 40 เซนติเมตร	ไม่น้อยกว่า 25 เซนติเมตร
จำนวนดอก/ช่อ	ไม่น้อยกว่า 12 ดอก	ไม่น้อยกว่า 9 ดอก	ไม่น้อยกว่า 7 ดอก
จำนวนดอกบาน/ช่อ	ไม่น้อยกว่า 9 ดอก	ไม่น้อยกว่า 7 ดอก	ไม่น้อยกว่า 5 ดอก

4 ข้อกำหนดเรื่องเกณฑ์ความคลาดเคลื่อน

เกณฑ์ความคลาดเคลื่อนเรื่องคุณภาพ ที่ยอมให้มีได้ในแต่ละภาชนะบรรจุ มีดังนี้

4.1 เกณฑ์ความคลาดเคลื่อนเรื่องคุณภาพ

4.1.1 ชั้นพิเศษ (“Extra” class)

ไม่เกินร้อยละ 5 ของกล้วยไม้ที่คุณภาพไม่เป็นไปตามข้อกำหนดของชั้นพิเศษ แต่เป็นไปตามคุณภาพชั้นหนึ่ง

4.1.2 ชั้นหนึ่ง (Class I)

ไม่เกินร้อยละ 10 ของกล้วยไม้ที่คุณภาพไม่เป็นไปตามข้อกำหนดของชั้นหนึ่ง แต่เป็นไปตามคุณภาพชั้นสอง

4.1.3 ชั้นสอง (Class II)

ไม่เกินร้อยละ 10 ของกล้วยไม้ที่คุณภาพไม่เป็นไปตามคุณภาพชั้นต่ำ รวมถึงไม่มีดอกเน่าเสียหรือสภาพไม่เหมาะสม

4.2 เกณฑ์ความคลาดเคลื่อนเรื่องขนาดความยาวช่อดอก

กล้วยไม้ทุกชั้น มีความยาวช่อดอก ยาวหรือสั้นกว่า ช่อชั้นถัดไปหนึ่งช่อ ปนมาได้ไม่เกินร้อยละ 10

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5 ข้อกำหนดเรื่องการบรรจุและการจัดเรียงเสนอ

5.1 ความสม่ำเสมอ

กล้วยไม้ที่บรรจุในแต่ละภาชนะบรรจุต้องมีความสม่ำเสมอ ทั้งในเรื่องของพันธุ์ คุณภาพ สีและขนาด ส่วนของดอกกล้วยไม้ที่มองเห็นในภาชนะบรรจุ ต้องเป็นตัวแทนของผลิตผลทั้งหมด

5.2 การบรรจุหีบห่อ

ต้องบรรจุกล้วยไม้ในลักษณะที่สามารถเก็บรักษาคุณภาพกล้วยไม้ได้เป็นอย่างดี ไม่แน่นเกินไปจนทำให้กล้วยไม้เสียหาย วัสดุที่ใช้ในการบรรจุต้องมีคุณภาพ สะอาด ป้องกันความเสียหายอันจะมีผลต่อกล้วยไม้

5.3 รายละเอียดบรรจุภัณฑ์

บรรจุภัณฑ์ต้องมีคุณภาพ ถูกสุขลักษณะ และมีคุณสมบัติทนทานต่อการปฏิบัติการขนส่ง และรักษาคุณภาพกล้วยไม้ได้ บรรจุภัณฑ์ต้องปราศจากกลิ่นและสิ่งแปลกปลอมที่มีผลกระทบต่อคุณภาพกล้วยไม้

6 การแสดงเครื่องหมายหรือฉลาก

ต้องมีข้อความแสดงรายละเอียดให้เห็นได้ชัดเจน ไม่หลุดลอก อ่านง่าย การใช้วัสดุโดยเฉพาะกระดาษหรือตราที่ประทับที่มีข้อกำหนดทางการค้าสามารถทำได้ หากการพิมพ์หรือการแสดงฉลากใช้หมึกพิมพ์หรือกาวที่ไร้พิษ บรรจุภัณฑ์สำหรับกล้วยไม้แบ่งได้เป็น 3 ประเภท คือ

6.1 บรรจุภัณฑ์สำหรับผู้บริโภค ต้องระบุข้อความ ดังต่อไปนี้

6.1.1 ประเภทของผลิตผล “กล้วยไม้” และหรือ “ชื่อพันธุ์กล้วยไม้”

6.1.2 ชั้นคุณภาพและชั้นขนาด

6.1.3 จำนวน และหรือ หน่วยบรรจุ

6.2 บรรจุภัณฑ์สำหรับผู้ขายส่ง ต้องระบุข้อความ ดังต่อไปนี้

6.2.1 ประเภทของผลิตผล “กล้วยไม้” และหรือ “ชื่อพันธุ์กล้วยไม้”

6.2.2 ชั้นคุณภาพและชั้นขนาด

6.2.3 จำนวน และหรือ หน่วยบรรจุ

6.2.4 ข้อมูลผู้ขายส่ง ได้แก่ ชื่อ ที่อยู่สถานที่บรรจุ

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6.3 บรรจุภัณฑ์สำหรับผู้ส่งออก ต้องระบุข้อความ ดังต่อไปนี้

6.3.1 ประเภทของผลิตผล “กล้วยไม้” และหรือ “ชื่อพันธุ์กล้วยไม้”

6.3.2 ชั้นคุณภาพและชั้นขนาด

6.3.3 จำนวน และหรือ หน่วยบรรจุ

6.3.4 ข้อมูลผู้ส่งออก ได้แก่ ชื่อ ที่อยู่ ประเทศ

6.4 ภาษา

การใช้ภาษาบนฉลากของบรรจุภัณฑ์กล้วยไม้ ต้องมีข้อความเป็นภาษาไทย เว้นแต่กรณีกล้วยไม้ที่ผลิตเพื่อการส่งออก ให้แสดงข้อความเป็นภาษาไทย และหรือ ภาษาราชการของประเทศคู่ค้า

6.5 เครื่องหมายการตรวจสอบทางราชการหรือเครื่องหมายรับรอง

ให้เป็นไปตามหลักเกณฑ์และเงื่อนไขของหน่วยตรวจสอบหรือหน่วยรับรองที่ได้รับการยอมรับจากกระทรวงเกษตรและสหกรณ์

7 วิธีชักตัวอย่าง

ให้เป็นไปตามข้อกำหนดในกฎหมายที่เกี่ยวข้อง และข้อกำหนดของมาตรฐานสินค้าเกษตรและอาหารแห่งชาติเรื่องวิธีชักตัวอย่างสำหรับไม้ตัดดอก

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APPENDIX B

TARGET POPULATION

Table B-1 Target population

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
1	KS 1184	นายดิเรก สว่างแสง	บ้านหนองตาพล 139	7	กระทุ่มล้ม	5
2	KS 1123	นายสนัด ศรีสวัสดิ์	46	9	กระทุ่มล้ม	15
3	KS 1081	นายวิชัย ชิ้วนฤภัย	82/1	7	คลองจินดา	10
4	KS 1082	นางสมศรี นิลจินดา	41	5	คลองจินดา	5
5	KS 1083	นายบุญเลิศ วรพัฒน์ไพบูลย์	107	3	คลองจินดา	5
6	KS 1084	นายสมจิตร ฮะหะโชติ	20	3	คลองจินดา	20
7	KS 1085	นายผดุง เล็กจินดา	50	13	คลองจินดา	25
8	KS 1086	นายบรรจง มรกตจินดา	1	10	คลองจินดา	20
9	KS 1087	นางสาวศุภนิจ การะเวก	71	13	คลองจินดา	25
10	KS 1088	นายอนันต์ ชิ้วนฤภัย	156	3	คลองจินดา	18
11	KS 1089	นายสนั่น รอดรักษา	43	3	คลองจินดา	15
12	KS 1090	นางนันท เจียระธรรม	193/1	3	คลองจินดา	8
13	KS 1091	นายบุญช่วย มรกตจินดา	1	5	คลองจินดา	20
14	KS 1092	นางบุญส่ง กอแสนสุข	126	3	คลองจินดา	2
15	KS 1095	นายสมาน สุขสวัสดิ์	14	1	คลองจินดา	5
16	KS 1096	นางประเทือง สรรพกิจชาญชัย	110	11	คลองจินดา	4.5
17	KS 1097	นายสมภพ เล็งสมาน	104	11	คลองจินดา	2
18	KS 1098	นางพรทิพย์ เกตุแก้ว	43/4	1	คลองจินดา	6
19	KS 1099	นายสมบูรณ์ โตสาคร	41/1	1	คลองจินดา	5
20	KS 1094	นายวิเชียร ห่วงถนอม	62	1	คลองจินดา	3
21	KS 1172	นางกันยา แสงพิทักษ์	บ้านดอนทอง 140	3	คลองใหม่	17
22	KS 1175	นายรัญจวน ยืนยง	บ้านคลองใหม่ 17/1	3	คลองใหม่	6
23	KS 1015	นายสนาน แสงพิทักษ์	72	3	คลองใหม่	50

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
24	KS 1016	นายประยงค์ เพ็งชุ่ม	145	2	คลองใหม่	9.75
25	KS 1017	นายบุญทอง เอี่ยมศริยารักษ์	69/1	5	คลองใหม่	18
26	KS 1018	นายลบ นุ่มนวล	68	7	คลองใหม่	3
27	KS 1019	นายหนู กลิ่นฉนอม	78	5	คลองใหม่	10
28	KS 1020	นายสินชัย น้อยพิทักษ์	2	3	คลองใหม่	10
29	KS 1134	นายสง่า จือวงษ์	บ้านคลองใหม่ 81	3	คลองใหม่	10
30	KS 3135	นายสำเริง เอี่ยมสะอาด	บ้านคลองใหม่ 5	1	คลองใหม่	12
31	KS 1157	นายผล การทวี	บ้านคลองใหม่ 72	5	คลองใหม่	4
32	KS 1162	นางสาวบุษลิน ขาวสำอางค์	บ้านคลองใหม่ 97/61	3	คลองใหม่	20
33	KS 1131	นายโยธิน ทองอุทัย	บ้านคลองเขื่อนขันธ์ 36	7	ตลาดจินดา	8
34	KS 1130	นายอภิชาติ วุฒิเสถียร	บ้านทรงคนอง 43/3	1	ทรงคนอง	20
35	KS 1211	นายสมศักดิ์ โป้สมบุญ	1/1	5	ท่าข้าม	5
36	KS 1166	นายกฤษณะ ปทุมาสูตร	22/2	4	ท่าตลาด	7
37	KS 1171	นางสำเนียง เตชะศิรินกูล	20/5	4	บางกระทึก	4
38	KS 1237	นายธงชัย เรืองประชานุกูล	28/2	8	บางกระทึก	4
39	KS 1238	นายสวิทชัย กลั่นประเสริฐ	บ้านคลองทวีวัฒนา 32/4	6	บางกระทึก	4.75
40	KS 1239	นางละมัย วงศ์กิจเจริญ	บ้านคลองทวีวัฒนา 39/1	6	บางกระทึก	5
41	KS 1240	นายชนะกิจ เนตรน้อย	บ้านใน 28/22	4	บางกระทึก	9
42	KS 1241	นายธนศักดิ์ โคเซียน	บ้านใน 70	4	บางกระทึก	5
43	KS 1242	นายพิเชษฐ ตันชนะประดิษฐ์	บ้านคลองทวีวัฒนา 34	6	บางกระทึก	25
44	KS 1012	นายกฤษณะ นาคไร่ขิง	25/2	1	บางกระทึก	4
45	KS 1013	นางสาวบุญเพ็ญ ตันติบุญยืน	21/2	6	บางกระทึก	10
46	KS 1021	นายบุญธรรม วัดเสนาะ	65/1	1	บางกระทึก	9
47	KS 1022	นายไมตรี เหมือนเนียม	54	1	บางกระทึก	5
48	KS 1023	นายวินัย ศรีสวัสดิ์	54/1	1	บางกระทึก	4
49	KS 1024	คุณมาลัย พุกทอง	21/3	1	บางกระทึก	3
50	KS 1025	คุณพยอม เส็งประชา	64/1	1	บางกระทึก	4
51	KS 1026	นายจำนงค์ สีผึ้ง	69	1	บางกระทึก	6
52	KS 1138	นายสมศักดิ์ เจิมสุจริต	บ้านดอนหวาย 134	5	บางกระทึก	10
53	KS 3139	นางบุญยก อัมราลิขิต	20/7	4	บางกระทึก	10
54	KS 2140	นางรัชดาพร อัมราลิขิต	20/7	4	บางกระทึก	16

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
55	KS 1141	นายอรุณ การะเวก	บ้านบางกระทึก 20/6	4	บางกระทึก	9.5
56	KS 1158	คุณจุไรรัตน์ วงศ์เมฆ	20/7	4	บางกระทึก	5
57	KS 1160	นายวิชัย สังฆ์ประสิทธิ์ผล	32/5	6	บางกระทึก	10
58	KS 1173	นายพยงค์ คงสกุล	32/1	1	บางช้าง	7
59	KS 1174	นายสมศักดิ์ ชื่นวารี	บ้านบางช้าง 26	1	บางช้าง	8
60	KS 1176	นายนิมิต คงอุดมทรัพย์	42	4	บางช้าง	5
61	KS 1179	นายชวน จรดล	บ้านบางม่วง 41	8	บางช้าง	5
62	KS 1180	นายประสิทธิ์ เทศสมบูรณ์	18	5	บางช้าง	12
63	KS 1181	นายสุรชัย รัตนาทร	10/2	5	บางช้าง	8
64	KS 1182	นายสมจิตร เจริญศิริ	ซอยประสบสุข 9/1	1	บางช้าง	10
65	KS 1183	นายชูศักดิ์ ชื่นเจริญ	บ้านซอยประสบสุข 12/2	1	บางช้าง	10
66	KS 1224	นางสิริวรรณ โตเลี้ยง	5/2	4	บางช้าง	5
67	KS 1225	นายพนม นาคสงวน	56	4	บางช้าง	15
68	KS 1056	นายวิวัฒน์ ฮวบอีบอน	บ้านศรีษะย่าน 4/6	10	บางช้าง	10
69	KS 1057	นายพยุง มณีโชติ	10/12	9	บางช้าง	10
70	KS 1058	นายจำนงค์ ยิ้มถนอม	1/1	6	บางช้าง	7
71	KS 1059	นายสวัสดิ์ เพ็งชุ่ม	3/1	6	บางช้าง	1
72	KS 1060	นายจเด็จ ยิ้มถนอม	102	6	บางช้าง	6
73	KS 2062	นายกุณรุทย์ ทองสมบูรณ์	59	6	บางช้าง	3
74	KS 1063	นายมนตรี เลี้ยงรักษา	17	5	บางช้าง	8
75	KS 1064	นายสมโภชน์ แก้วสมบูรณ์	10	9	บางช้าง	6
76	KS 1065	นายชวน จรดล	41	1	บางช้าง	3
77	KS 1066	นายชรินทร์ ปานเจริญ	8/6	4	บางช้าง	4
78	KS 1067	นายศิริ ปานเจริญ	8/4	4	บางช้าง	16
79	KS 1068	นายพยงค์ คงอุดมทรัพย์	50/1	5	บางช้าง	3
80	KS 1070	นางนิภา ใช้เจริญ	30/2	9	บางช้าง	6
81	KS 1076	นายสมศักดิ์ ชื่นวารี	26	1	บางช้าง	7
82	KS 1078	นายชูศักดิ์ ชื่นเจริญ	38760	1	บางช้าง	7
83	KS 1079	นายชม สุขพูนพร้อม	38727	9	บางช้าง	13
84	KS 1080	นางไมตรี เลี้ยงบำรุง	4	5	บางช้าง	4
85	KS 1093	นายมาโนช สุรเสียง	44	7	บางช้าง	3

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
86	KS 1107	นายวิวัฒน์ ลิ้มสงวน	บ้านศรีษะย่าน 5/5	10	บางช้าง	14
87	KS 1108	นายอรุณ ลิ้มสงวน	บ้านศรีษะย่าน 5/2	10	บางช้าง	6
88	KS 1109	นางสาวสุนิษา จิตรสมบุญ	บ้านคลองบางม่วง 21	9	บางช้าง	0.5
90	KS 1111	นายพยุง สอนสมบูรณ์	บ้านบางม่วง 49/2	8	บางช้าง	2.5
91	KS 1112	นายโชติ ลิ้มสงวน	5	10	บางช้าง	10
92	KS 1114	นายวิรัช แก้วสมบูรณ์	บ้านศรีษะย่าน 10	10	บางช้าง	5
93	KS 1159	นางสมใจ แก้วสมบูรณ์	10/10	9	บางช้าง	5
94	KS 1243	นายมานะ คูเจริญชัยมานที	บ้านคลองสามพราน 116	1	บางเตย	8
95	KS 1244	นางสิริเพ็ญ อัมราลิขิต	44	1	บางเตย	4
96	KS 1245	นายสมเกียรติ ดุสฎีกาญจน	109	1	บางเตย	20
97	KS 1167	นายสมชาติ ตันเสถียร	บ้านสวนส้ม 1	5	บ้านใหม่	10
98	KS 1217	นางน้อย ทิวากรเนืองนิตย์	บ้านสวนส้ม 57	5	บ้านใหม่	7
99	KS 1218	นายวันชัย ลิ้มรักษา	บ้านสวนส้ม 10/2	5	บ้านใหม่	6.5
100	KS 1219	นางระเบียบ โตรักษา	บ้านเทียนดัด 66/4	1	บ้านใหม่	3
101	KS 1220	นายเจด็จ เฟื่องฝน	บ้านสวนส้ม 74/1	5	บ้านใหม่	4
102	KS 1221	นางจิตรา โตรักษา	66/4	1	บ้านใหม่	3
103	KS 1222	นางวันทนา โตรักษา	บ้านสวนส้ม 74/1	5	บ้านใหม่	2
104	KS 2223	นายสมิทธิ เล็งเจริญ	บ้านบ้านใหม่ 53/1	1	บ้านใหม่	6
105	KS 1227	นายไกรศร พูลสวัสดิ์	55/2	5	บ้านใหม่	5
106	KS 1228	นายจรัญ อนุตธโต	บ้านสวนส้ม 81/1	5	บ้านใหม่	5
107	KS 1001	นายทวีป ชุนภารุณย์	48	3	บ้านใหม่	2
108	KS 1002	นายสุเทพ เกิดท่าไม้	63/1	3	บ้านใหม่	3.25
109	KS 1004	นายจำรัส เกตุรักษา	50/3	3	บ้านใหม่	4
110	KS 1005	นายกำจัด บุญประคอง	7/1	3	บ้านใหม่	20
111	KS 1007	นายสะอาด อนุตรโต	66/14	1	บ้านใหม่	4.5
112	KS 1009	นางระเบียบ ตั้งต้นเจริญ	12/1	3	บ้านใหม่	4
113	KS 1010	นายอนุชา ชัยสมบูรณพันธ์	79	5	บ้านใหม่	12
114	KS 1011	นายนิพนธ์ ชัยสมบูรณพันธ์	72	2	บ้านใหม่	7
115	KS 1115	นายสวง หอมทอง	บ้านสวนส้ม 21/4	1	บ้านใหม่	5
116	KS 1116	นายสมชาย ภู่ทอง	บ้านเก่า 68	2	บ้านใหม่	6.5
117	KS 1117	นายประยูร สุขสวัสดิ์	บ้านวัดเทียนดัด 28	5	บ้านใหม่	4

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
118	KS 1118	นายนคร ชัยสมบูรณ์พันธ์	บ้านสวนส้ม 80	5	บ้านใหม่	6
119	KS 1119	นางสาวบุญผ่อง แดงสวัสดิ์	บ้านสวนส้ม 65	5	บ้านใหม่	2
120	KS 1120	นางธิดา อินยาศรี	บ้านสวนส้ม 80	5	บ้านใหม่	5
121	KS 1121	นายทวี เล็กประเสริฐ	บ้านบางประแดง 12	3	บ้านใหม่	3.25
122	KS 1145	นางยุพา บุญบางยาง	54/1	3	บ้านใหม่	6
123	KS 1146	นายบรรจง ชิ้มเจริญ	บ้านสวนส้ม 15	5	บ้านใหม่	3
124	KS 1147	นายสนิท สุวรรณ	77	5	บ้านใหม่	8
125	KS 1148	นายชัยศรี ลิ้มรักษา	บ้านสวนส้ม 41/3	5	บ้านใหม่	2.5
126	KS 1149	นายสมบัติ ตันเสถียร	บ้านสวนส้ม 40/2	5	บ้านใหม่	5
127	KS 1150	นายวันชัย ริ้วบำรุง	60/7	5	บ้านใหม่	10
128	KS 1151	นายเทียนทอง ชัยสมบูรณ์พันธุ์	7/1	5	บ้านใหม่	2
129	KS 1164	นายเวียงชัย ริ้วบำรุง	46	5	บ้านใหม่	9
130	KS 1132	นายอารักษ์ บำรุงกิจ	บ้านยายชา 59	3	ยายชา	5
131	KS 3133	นายทวี แดงสวัสดิ์	บ้านสวนส้ม 15	2	ยายชา	3.5
132	KS 1014	นายสวัสดิ์ สมไร่ขิง	12	12	ไร่ขิง	6
133	KS 3136	นายฉลอง จันทราภาษ	67/1	12	ไร่ขิง	15
134	KS 1137	คุณพรเทพ ตรีเวชอักษร	35/4	12	ไร่ขิง	15
135	KS 1177	นายประสิทธิ์ ภูมิสามพราน	32	9	สามพราน	7
136	KS 1185	นายไพบูลย์ น้อยวิจิตร	9/1	5	สามพราน	4
137	KS 1186	นายสมศักดิ์ พุ่มเจริญ	บ้านดงเกตุ 72	5	สามพราน	4
138	KS 1188	นายเสน่ห์ คูรัตนพันธ์	บ้านดงเกตุ 66/1	5	สามพราน	3
139	KS 1189	นางลำยอง จงเจริญ	บ้านดงเกตุ 63/1	5	สามพราน	3
140	KS 1190	นายวิจิตร พุ่มเจริญ	บ้านดงเกตุ 80	5	สามพราน	4
141	KS 1191	นายประสาน พัฒนานันท์	65	5	สามพราน	8
142	KS 1192	นายสุเทพ แพถนอม	51	5	สามพราน	14
143	KS 1193	นายสัมประสิทธิ์ บัวอุบล	บ้านดงเกตุ 89/5	6	สามพราน	10
144	KS 1194	นายโสภณ แดงสมบูรณ์	บ้านดงเกตุ 37/6	6	สามพราน	6
145	KS 1195	จ.ส.ต.วิชิต มาลัยเปีย	บ้านดงเกตุ 43/3	4	สามพราน	8
146	KS 1196	นายบุญเสริม พัฒนานันท์	55/4	5	สามพราน	3
147	KS 3200	นางจิตรา ไพบูลย์สินสมบัติ	บ้านดงเกตุ 25/2	6	สามพราน	15
148	KS 1201	นายมาโนช สุขสกุลวัฒน์	บ้านดงเกตุ 18	9	สามพราน	16

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
149	KS 1202	นายจรัส คงเจริญ	บ้านดงเกตุ 24	3	สามพราน	6
150	KS 1204	นายโสภณ เรืองแก้วมณี	32/3	6	สามพราน	10
151	KS 1212	นายสุวัฒน์ กาญจนวาภะ	บ้านดงเกตุ 21/3	3	สามพราน	6
152	KS 1213	นายสามารถ อุณหบัณฑิต	บ้านดงเกตุ 43/3	3	สามพราน	10
153	KS 1214	นางลิ้ม โป้สมบูรณ์	บ้านดงเกตุ 9/2	2	สามพราน	4
154	KS 1215	นายสุพจน์ โป้สมบูรณ์	บ้านดงเกตุ 34	3	สามพราน	10
155	KS 1216	นายสิทธินนท์ กิจประชุม	บ้านดงเกตุ 28/2	6	สามพราน	6
156	KS 1226	นายวินัย บุญบางยาง	บ้านดงเกตุ 63	2	สามพราน	5
157	KS 1027	นางสาวลัดดาวัลย์ ทวีสินสถิตย์	20	2	สามพราน	3
158	KS 1029	นายสมยศ มอญถนอม	38/3	2	สามพราน	2
159	KS 1032	นายไมตรี อิศราสุชีพ	37/1	2	สามพราน	2
160	KS 1033	นายสมมาตร อุณหบัณฑิต	5	3	สามพราน	8
161	KS 1034	นายโฆษิต เอี่ยมสำอางค์	30	3	สามพราน	15
162	KS 1035	นางธิดา นาคสงวน	26	3	สามพราน	5
163	KS 1036	นายมนตรี เอี่ยมสำอางค์	30	3	สามพราน	4.3
164	KS 1037	นายสมพงษ์ แดงสมบูรณ์	22/2	3	สามพราน	8
165	KS 1038	นายมาโนช ปิ่วท่าไม้	36	4	สามพราน	12
166	KS 1039	นายดิเรก อาจณรงค์	51/3	4	สามพราน	2
167	KS 1040	นางครองสิน เอี่ยมสำอางค์	38	4	สามพราน	6
168	KS 1041	นายรักชาติ ลิ้มรักษา	13/1	4	สามพราน	1
169	KS 1042	นางตอง ปิ่วท่าไม้	36/1	4	สามพราน	0.75
170	KS 1043	นางสว่าง วารี	35	4	สามพราน	0.75
171	KS 1044	คุณสำรอง ประสงค์ดี	32	5	สามพราน	30
172	KS 1045	นางสาวสมศรี เลิศจันทร์เพ็ญ	29	4	สามพราน	3
173	KS 1046	นายเอนก แช่มสาคร	6/1	4	สามพราน	12
174	KS 1047	นางสายพา แช่มสาคร	6	4	สามพราน	3
175	KS 1048	พ.ต.เสนาะ อาภาวิลาศ	38/1	4	สามพราน	6
176	KS 1049	นางเฉลียว เลี้ยงรักษา	45	4	สามพราน	12.5
177	KS 1050	นางฉันทนา ฝอยฝน	49/1	4	สามพราน	2
178	KS 1051	นายประดิษฐ์ ดีฉ่ำ	66/1	5	สามพราน	0.75
179	KS 1052	นายสมปอง รัตนาวิทย์	63	5	สามพราน	6

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
180	KS 1053	นายสมนึก แซ่เฮ้ง	63	5	สามพราน	3
181	KS 1054	นางวนิดา ดูรัตนพันธ์	66	5	สามพราน	3
182	KS 1055	นายสมุทร เดชกำแหง	72	5	สามพราน	2.5
183	KS 1100	นายพิศ มอญฉนอม	บ้านหงษ์ 43	2	สามพราน	4
184	KS 1122	นายจรวย คงเจริญ	บ้านศรีษะย่าน 24	3	สามพราน	2
185	KS 1124	นายถาวร คงเจริญ	บ้านศรีษะย่าน 24	3	สามพราน	5
186	KS 1125	นายสมศักดิ์ ศุภวิทยามงคล	บ้านคลองหีบหิน 14/1	6	สามพราน	3
187	KS 1128	นายวิรัช เย็นสบาย	บ้านคลองแค 14	9	สามพราน	2
188	KS 1129	นายสมศักดิ์ พุ่มเจริญ	บ้านโรงหีบ 80/1	5	สามพราน	4
189	KS 1152	นายพัฒนชัย ศรีสมบูรณ์	55/3	5	สามพราน	6
190	KS 1154	นายบุญสม จรดล	บ้านคลองแค 32/1	9	สามพราน	25
191	KS 1156	นายประเสริฐ สุขสกุลวัฒน์	18	9	สามพราน	2
192	KS 1168	นายประวิทย์ เตียรักษา	บ้านอ้อมใหญ่ 14/1	1	อ้อมใหญ่	4
193	KS 1169	นายสุเทพ น้อยรักษา	บ้านอ้อมใหญ่ 21/3	1	อ้อมใหญ่	3
194	KS 1170	นางดาวน้อย อ่อนนาคคล้ำ	บ้านอ้อมใหญ่ 14	1	อ้อมใหญ่	6
195	KS 1229	นายสังข์ พริ้งรักษา	บ้านอ้อมใหญ่ 45/13	8	อ้อมใหญ่	5
196	KS 1230	นางนิดา โตรักษา	บ้านอ้อมใหญ่ 46/3	8	อ้อมใหญ่	7
197	KS 1231	นายนิกร สุรเสียง	บ้านอ้อมใหญ่ 63	5	อ้อมใหญ่	6
198	KS 1232	นายทวีลาภ กวยเจริญ	บ้านอ้อมใหญ่ 26/43	8	อ้อมใหญ่	5
199	KS 1234	นายประยงค์ โตเลี้ยง	37	6	อ้อมใหญ่	6
200	KS 1235	นายแป้น สาตรพันธุ์	บ้านอ้อมใหญ่ 16/2	3	อ้อมใหญ่	10
201	KS 1236	นายไพโรจน์ แก้วมณี	บ้านอ้อมใหญ่ 10/2	4	อ้อมใหญ่	8
202	KS 1003	นายสมศักดิ์ อุ่นพุฒิกุล	9/1	1	อ้อมใหญ่	
203	KS 1006	นายวิเชียร พริ้งรักษา	23	4	อ้อมใหญ่	2
204	KS 1008	นางสมบัติ อิ่มทิพย์	8/2	1	อ้อมใหญ่	10
205	KS 1101	นางธิดา ศาสตร์พันธุ์	บ้านอ้อมใหญ่ 34	2	อ้อมใหญ่	5
206	KS 1102	นายภานุวัตร มากคง	บ้านอ้อมใหญ่ 34/1	2	อ้อมใหญ่	3
207	KS 3103	นายเทียนทอง ชัยสมบูรณ์พันธุ์	7/1	5	อ้อมใหญ่	2.25
208	KS 1104	นายสมเกียรติ อิศราสุชีพ	บ้านอ้อมใหญ่ 23/2	4	อ้อมใหญ่	4
209	KS 1105	นางศิริพร ตรีชั้น	บ้านอ้อมใหญ่ 8/2	5	อ้อมใหญ่	3
210	KS 1106	นายผดุงศักดิ์ โพธิ์รักษา	บ้านอ้อมใหญ่ 19	1	อ้อมใหญ่	8

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Table B-1 Target population (Cont.)

ลำดับที่	รหัสทะเบียน	ชื่อ-สกุล	เลขที่	หมู่	ตำบล	จำนวนไร่
211	KS 1142	นายสมชาย สาตรพันธุ์	8/1	1	อ้อมใหญ่	3
212	KS 1143	นายบุญทรง สาตรพันธุ์	8	1	อ้อมใหญ่	3
213	KS 1144	นายสมเกียรติ ชิวหา	9	1	อ้อมใหญ่	6
214	KS 1153	คุณสุนีย์ คงเจริญ	บ้านศรีษะย่าน 24	3	อ้อมใหญ่	4

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APPENDIX C
QUESTIONAIRE

แบบสอบถาม
เรื่อง
การประยุกต์ใช้เทคโนโลยีชีวภาพในการการปลูกกล้วยไม้สกุลหวาย :
กรณีศึกษา อำเภอสามพราน จังหวัดนครปฐม

***หมายเหตุ** คำตอบของท่านทุกข้อ ผู้วิจัยถือว่าเป็นความลับที่สำคัญยิ่ง เพื่อนำไปใช้ประโยชน์ในการทำวิทยานิพนธ์เท่านั้น ไม่มีผลต่อตัวท่านในทางใด ๆ ทั้งสิ้น ดังนั้นจึงขอให้ท่านตอบคำถามให้ตรงกับข้อเท็จจริงมากที่สุด

แบบสอบถามนี้เป็นเครื่องมือในการเก็บรวบรวมข้อมูล เพื่อใช้ในการทำวิทยานิพนธ์ ของนางสาวศศิวรรณ ธรรมิกบวร นักศึกษาสาขาวิชาการวางแผนสิ่งแวดล้อมเพื่อพัฒนาชุมชนและชนบท คณะสิ่งแวดล้อมและทรัพยากรศาสตร์ มหาวิทยาลัยมหิดล

คำชี้แจง

แบบสอบถามชุดนี้ มีจำนวน 6 หน้า รวมใบปะหน้าด้วย แบ่งออกเป็น 5 ส่วน คือ

ส่วนที่ 1 ข้อมูลพื้นฐานทางเศรษฐกิจและสังคมของเกษตรกร

ส่วนที่ 2 ข้อมูลทั่วไปของสวน

ส่วนที่ 3 ข้อมูลการเพิ่มผลผลิตและการปรับปรุงคุณภาพกล้วยไม้

ส่วนที่ 4 ข้อมูลการป้องกันศัตรูกล้วยไม้

ส่วนที่ 5 ข้อมูลการใช้จุลินทรีย์ที่มีประสิทธิภาพ (EM) ในการปลูกกล้วยไม้

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วันที่ ..... เดือน พฤศจิกายน พ.ศ. 2548
ชื่อผู้ให้สัมภาษณ์ .....
ที่ตั้งสวน ..... ตำบล ..... อำเภอสามพราน จังหวัดนครปฐม
ชื่อผู้สัมภาษณ์ นางสาวศศิวรรณ ธรรมิกบวร

ส่วนที่ 1 ข้อมูลพื้นฐานทางเศรษฐกิจและสังคมของเกษตรกร

1. เพศ ( ) ชาย ( ) หญิง
2. อายุ ..... ปี
3. ระดับการศึกษาสูงสุด ( ) ไม่ได้เข้ารับการศึกษา ( ) ประถมศึกษา ( ) มัธยมศึกษา
   ( ) อาชีวศึกษา ( ) อุดมศึกษาหรือสูงกว่า
4. ประสบการณ์ปลูก ปลูกมาแล้ว ..... ปี มีประสบการณ์จาก
   ( ) เรียนรู้ด้วยตนเอง ( ) สืบทอดกันมาจาก.....
   ( ) ฝึกอบรมจาก .....
5. แรงงานในการทำสวน มีทั้งหมด ..... คน
   ( ) แรงงานคนในครอบครัว จำนวน ..... คน
   ( ) แรงงานคนนอกครอบครัว จำนวน ..... คน
6. รายได้จากการทำสวน ..... บาท/เดือน
7. การรับรู้ข่าวสารทางการเกษตร
   ( ) เพื่อนบ้าน/เพื่อนสมาชิกชมรม ( ) เจ้าหน้าที่ของรัฐ ระบุ .....
   ( ) วารสาร/หนังสือพิมพ์ ( ) วิทยุ โทรทัศน์
   ( ) อื่น ๆ .....
8. การเข้าร่วมฝึกอบรมเกี่ยวกับการปลูกกล้วยไม้
   ( ) ไม่เคย
   ( ) เคย เรื่อง ..... โดยหน่วยงาน .....
   เรื่อง ..... โดยหน่วยงาน .....
   เรื่อง ..... โดยหน่วยงาน .....

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ส่วนที่ 2 ข้อมูลทั่วไปของสวน

9. ขนาดพื้นที่ ..... ไร่

10. ไม่เป็นที่ลุ่ม หรือมีน้ำท่วมขัง ( ) ใช่ ( ) ไม่ใช่

11. การคมนาคมขนส่งสะดวก สามารถนำผลผลิตออกสู่ตลาดได้รวดเร็ว ( ) ใช่ ( ) ไม่ใช่

12. ไม่มีร่มเงาจากสิ่งก่อสร้าง ( ) ใช่ ( ) ไม่ใช่

13. ไม่อับลม หรือมีลมแรงเกินไป ( ) ใช่ ( ) ไม่ใช่

14. การเก็บกล้วยไม้ในโรงเรือน ( ) ตั้งโต๊ะ ( ) แขวน

15. วัสดุปลูก

( ) กาบ / กระบะมะพร้าว ( ) กระถางดินเผา ( ) อื่น ๆ .....

16. น้ำที่ใช้

( ) น้ำฝน ( ) น้ำคลอง / น้ำแม่น้ำ ( ) อื่น ๆ .....

17. คุณภาพน้ำต่อการปลูกกล้วยไม้

( ) ดี ( ) พอใช้ ( ) ไม่ดี

18. ปริมาณน้ำ

( ) เพียงพอสำหรับการปลูกตลอดทั้งปี

( ) ไม่เพียงพอสำหรับการปลูกตลอดทั้งปี ระบุช่วงเวลาที่ขาดน้ำ .....

19. ความถี่ที่ให้น้ำ

( ) 1 ครั้ง/วัน ( ) 2 ครั้ง/วัน ( ) 2 วัน/ครั้ง ( ) อื่น ๆ .....

20. ช่วงเวลาการให้น้ำ

( ) เช้า ( ) เย็น ( ) เช้าและเย็น ( ) อื่น ๆ .....

21. วิธีการให้น้ำ

( ) ใช้สายยางฉีดไปตามต้น ( ) ระบบท่อจ่ายน้ำ ( ) อื่น ๆ .....

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ส่วนที่ 3 ข้อมูลการเพิ่มผลผลิตและการปรับปรุงคุณภาพกล้วยไม้

22. การใช้ปุ๋ย ( ) ไม่ใช้
( ) ใช้

ปุ๋ยอินทรีย์ ได้แก่ ..... ปุ๋ยอนินทรีย์ ได้แก่ .....
ปริมาณ ..... ปริมาณ .....
ความถี่ที่ให้ปุ๋ย ..... ความถี่ที่ให้ปุ๋ย .....
ช่วงเวลาการให้ปุ๋ย ..... ช่วงเวลาการให้ปุ๋ย .....
วิธีการให้ปุ๋ย ..... วิธีการให้ปุ๋ย .....
เหตุผลที่เลือกใช้วิธีนี้ .....

23. การดูแลช่อและดอก

( ) ปล่อยตามธรรมชาติ ( ) มีการใช้สารเคมี
ชื่อสาร .....
ปริมาณ .....
ความถี่ที่ให้ .....
เวลาที่ให้ .....
วิธีการให้สาร .....
( ) ใช้วิธีการอื่น ๆ .....
เหตุผลที่เลือกใช้วิธีนี้ .....

24. การเร่งดอก

( ) ปล่อยตามธรรมชาติ ( ) มีการใช้สารเร่ง
ชื่อสาร .....
ปริมาณ .....
ความถี่ที่ให้ .....
เวลาที่ให้ .....
วิธีการให้สาร .....
( ) ใช้วิธีการอื่น ๆ .....
เหตุผลที่เลือกใช้วิธีนี้ .....

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ส่วนที่ 4 ข้อมูลการป้องกันโรคในกล้วยไม้

25. การเกิดโรค

( ) ไม่เกิดโรค ( ) เกิดโรค (ระบุ) ……..

26. การป้องกันกำจัดโรค

( ) ปล่อยตามธรรมชาติ ( ) มีการใช้สารเคมี

ชื่อสาร ……

ปริมาณ .....

ความถี่ที่ให้ ……

เวลาที่ให้ .....

วิธีการให้สาร …….....

( ) ใช้วิธีการอื่น ๆ .....

เหตุผลที่เลือกใช้วิธีนี้ .....

27. แมลงศัตรูกล้วยไม้

( ) ไม่มีแมลง ( ) มีแมลง (ระบุ) ……

28. การป้องกันกำจัดแมลง

( ) ปล่อยตามธรรมชาติ ( ) มีการใช้สารเคมี

ชื่อสาร ……

ปริมาณ .....

ความถี่ที่ให้ ……

เวลาที่ให้ .....

วิธีการให้สาร …….....

( ) ใช้วิธีการอื่น ๆ .....

เหตุผลที่เลือกใช้วิธีนี้ .....

29. วัชพืชกล้วยไม้

( ) ไม่มีวัชพืช ( ) มีวัชพืช (ระบุ) ……..

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30. การป้องกันกำจัดวัชพืช

( ) ปล่อยตามธรรมชาติ ( ) มีการใช้สารเคมี

ชื่อสาร .....

ปริมาณ .....

ความถี่ที่ให้ .....

เวลาที่ให้ .....

วิธีการให้สาร .....

( ) ใช้วิธีการอื่น ๆ .....

เหตุผลที่เลือกใช้วิธีนี้ .....

ส่วนที่ 5 ข้อมูลการใช้จุลินทรีย์ที่มีประสิทธิภาพ (EM) ในการปลูกกล้วยไม้

หมายเหตุ EM ในที่นี้ หมายถึง ปุ๋ยอินทรีย์น้ำ ปุ๋ยหมักชีวภาพ น้ำหมักชีวภาพ

31. ท่านรู้จัก EM หรือไม่ ( ) ไม่รู้

( ) รู้ ด้านใด .....

32. ท่านรู้จัก EM จากที่ใดเป็นครั้งแรก

( ) เพื่อนบ้าน/เพื่อนสมาชิกชมรม ( ) เจ้าหน้าที่ของรัฐ ระบุ.....

( ) วารสาร/หนังสือพิมพ์ ( ) วิทยุ โทรทัศน์

( ) อื่น ๆ .....

33. ท่านเคยได้รับความรู้เกี่ยวกับการใช้ EM ในการปลูกกล้วยไม้หรือไม่

( ) ไม่เคย ( ) เคย

34. ถ้าเคยท่านได้รับความรู้เกี่ยวกับการใช้ EM ในการปลูกกล้วยไม้จากแหล่งใดมากที่สุด

( ) เพื่อนบ้าน/เพื่อนสมาชิกชมรม ( ) เจ้าหน้าที่ของรัฐ ระบุ.....

( ) วารสาร/หนังสือพิมพ์ ( ) วิทยุ โทรทัศน์

( ) อื่น ๆ .....

35. ท่านเคยใช้ EM ในการปลูกกล้วยไม้หรือไม่

( ) ไม่เคย ( ) เคย เพื่อ .....

36. ปัจจุบันท่านยังใช้ EM ในการปลูกกล้วยไม้หรือไม่

( ) ใช้ เพราะ .....

( ) ไม่ใช้ เพราะ .....

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APPENDIX D
EM SAMPLE

1. **EM formula A:** Local Community Development Project, Community Organizations Development Institute (Public Organization) in Tambon Bangchang, Sampran District, Nakhonpathom Province

Ingradient

Excretion of a bat	1.0	kg
Molass	1.0	kg
Brown sugar	1.0	kg
Nutrient elements	0.5	kg
Coconut water	15.0	L
Microorganisms	2.0	tablespoon
Hormone	2.0	kg

Hormone was fermented from chicken carcase 10 kg, molass 3 kg, pineapple 1 kg, bran 5 kg, coconut water 20 L and microorganisms (Nasilone) 2 tablespoon for 7 days. Then add rice 4 kg, 20 eggs and milk 2 cans in the 8th day, mixed thoroughly and ferment upto 30 days. Mixed thoroughly every 3 days.

2. **EM formula B:** TISTR

Ingradient

Fish	100	kg
Phosphoric acid	3.5	L
Molass	20	L
NaOH	for adjust pH to be 6.0-6.5	

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3. EM formula C: INS Calibre Microorganism Bio-Fertilizer

Ingradient

1) Organic matter

- Aloe Vera
- Humic acid
- Amino acid

2) Inorganic matter

- Primary nutrient elements: Nitrogen, Phosphorus and Potassium
- Secondary nutrient elements: Calcium, Magnesium and Sulphur
- Plant micronutrients: Copper, Boron, Manganese, Zinc, Molypdenum and Iron

3) Bacteria

Azospirillum sp., *Rhizobium* sp., *Bacillus pumillus*, *Lactobacillus*, Nitrifying Bacteria, Yeast, Photosynthetic Bacteria, Growth Factors Producing Bacteria and Actinomycetes

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APPENDIX E
CULTURAL MEDIA

1. Bacteria media

Glucose	5.0	gm
Peptone	5.0	gm
$MgSO_4.7H_2O$	0.5	gm
Yeast extract	0.5	gm
Agar	15.0	gm
Actidione	30.0	ppm

The ingredient were dissolved in 1,000 mL of distilled water and then steriled by autoclave at 121°C, 15 min. After autoclaving, 4 mL of 30 ppm actidione was added.

2. Fungi media

Glucose	6.0	g
$(NH_4)_2SO_4$	2.0	g
KH_2PO_4	0.6	g
K_2HPO_4	0.4	g
$MgSO_4.7H_2O$	0.5	g
Ferric citrate	10.0	mg
$ZnSO_4.7H_2O$	4.4	mg
$MnSO_4.4H_2O$	5.0	mg
$CaCl_2$	55.0	mg
$CoCl_2.6H_2O$	1.0	mg

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Thiamine hydrochloride	100.0	mg
Yeast extract	1.0	g
Agar	15.0	g
Streptomycin	30.0	ppm

The ingredient were dissolved in 1,000 mL of distilled water and then steriled by autoclave at 121°C, 15 min. After autoclaving, 4 mL of 30 ppm streptomycin was added.

3. Actinomycetes media

Glucose	6.00	g
$(NH_4)_2SO_4$	1.00	g
KH_2PO_4	0.80	g
K_2HPO_4	0.22	g
$Na_2HPO_4.7H_2O$	0.33	g
$MgSO_4.7H_2O$	0.50	g
$CuSO_4.5H_2O$	0.001	g
$FeSO_4.7H_2O$	0.001	g
$MnSO_4.7H_2O$	0.001	g
$ZnSO_4.nH_2O$	0.001	g
Yeast extract	0.10	g
Agar	15.00	g
Actidione	30.00	ppm

The ingredient were dissolved in 1,000 mL of distilled water and then steriled by autoclave at 121°C, 15 min. After autoclaving, 4 mL of 30 ppm actidione was added.

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4. Typtic soy broth (TSB)

Pancreatic digest of casein	15.0	g
Enzymatic digest of soybean meal	5.0	g
Sodium chloride	5.0	g
Agar	15.0	g

The ingredient were dissolved in 1,000 mL of distilled water and then steriled by autoclave at 121°C, 15 min.

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APPENDIX F

RESULT FROM QUESTIONAIRE

Table F-1 Personal characteristics

Agriculturist's personal information		Number
1) Gender		
Male		52
Female		20
	Total	72
2) Age (years)		
21 - 30		1
31 - 40		10
41 - 50		27
51 - 60		20
61 - 70		11
71 – 80		3
	Total	72
Mean = 51.46	S.D. = 10.33	
Min = 29.00	Max = 75.00	
3) Level of education		
No education		0
Primary school		48
Secondary school		15
Vocational education		3
Bachelor level or higher		6
	Total	72
4) Experience in orchid cultivation		
4.1 Experience range (years)		
1 - 10		12
11 - 20		36
21 - 30		18
31 - 40		6
	Total	72
4.2 Sources of experience		
Self-study		63
Local wisdom		9
Training		0
	Total	72
Mean = 18.89	S.D. = 8.15	
Min = 2.00	Max = 40.00	

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Table F-1 Personal characteristics (Cont.)

Agriculturist's personal information		Number
5) labors who work in orchid farm		
5.1 The number of labor		
1 – 5		49
6 – 10		21
11 – 15		2
	Total	72
Mean = 4.25	S.D. = 2.67	
Min. = 1.00	Max = 15.00	
5.2 Sources of labor		
Inside family		22
Outside family		6
Both items		44
	Total	72
5.3 Labor inside family (person)		
1		15
2		38
3		7
4		5
5		1
	Total	66
Mean = 2.04	S.D. = 0.91	
Min. = 1.00	Max = 5.00	
5.4 Labor outside family (person)		
1 - 5		45
6 - 10		4
11 - 15		1
	Total	50
Mean = 3.19	S.D. = 2.35	
Min. = 1.00	Max = 13.00	
6) Income (baths/month)		
1 - 10,000		11
10,001 - 20,000		31
20,001 - 30,000		11
30,001 - 40,000		6
40,001 - 50,000		9
50,001 - 60,000		0
60,001 - 70,000		1
70,001 - 80,000		2
80,001 - 90,000		0
90,001 - 100,000		1
	Total	72
Mean = 24,079.86	S.D. = 18,732.97	
Min. = 6,000.00	Max = 100,000.00	

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Table F-1 Personal characteristics (Cont.)

Agriculturist's personal information	Number
7) Access in formation concerning agricultural	
Talking with neighbour and member club	41
Government officer	14
Journal/Newspaper	8
Radio/Television	1
Other	8
Total	72
8) Training / Seminar / Conference and Meeting about orchid cultivation	
8.1 No participated	31
Participated	41
Total	72
8.2 Topics of Training:	
- EM / Biofertilizer for orchid cultivation	3
- Thailand standard for orchids	7
- Plant pathogen / Plant pest of orchid	8
- Orchid cultivation follow by GAP method	11
- Chemical fertilizer and pesticide usage	12
Total	41
8.3 Training organization:	
- Pesticide company/store	6
- Agricultural occupation development and promotion centre; Samutsakhon Province	7
- Tambon agricultural officer	8
- District agricultural officer	20
Total	41

Table F-2 General information of orchid farm

General information of orchid farm	Number
1) Size of farm area (Rai)	
1 - 10	52
11 - 20	16
21 - 30	3
31 - 40	1
Total	72
2) Geographic location of farm	
Plain	57
Floodplain area	15
Total	72
3) Convenient to access in farm by ground transportation	72
4) Plain area and open space	72
5) Air flow pass through the farm	72
6) Orchids were placed on the table	72

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Table F-2 General information of orchid farm (Cont.)

General information of orchid farm	Number
7) Types of plantation materials	
Coconut fibrous and husk	72
8) Use water from river or canel	72
9) The quality of water for orchid cultivation	
Good	40
Medium	28
Poor	4
Total	72
10) The quantity of water for orchid cultivation	
Enough for orchid cultivation all over year	69
Not enough for orchid cultivation all over year	3
Total	72
11) The frequency of watering	
1 times / day	42
2 times / day	4
2 days / time	23
3-4 days / time	3
Total	**72**
12) The duration time of watering	
In the morning	56
At noon	0
In the evening	2
Both of morning and evening	2
Others	12
Total	72
13) Watering method	
Manual watering	30
Sprinkler system	32
Others	10
Total	72

Table F-3 Method for increasing and improving the quantity and quality of product

Method for increasing and improving the quantity and quality of product	Number
1) Method for increasing product quantity	
No adding any substance	8
Chemical substance added	64
Total	72
2) Method for improving product quality	
No adding any substance	9
Chemical substance added	63
Total	72

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Table F-4 Method for plant diseases and plant pests protection and weeds control

Method for plant diseases and plant pests protection and weeds control	Number
1) Plant diseases problem	72
2) Use chemical substances for plant diseases protection	72
3) Plant pests problem	72
4) Method for plant pests protection	
Natural control	0
Chemical substance usage	71
Others	1
Total	72
5) Weeds problem	72
6) Method for weeds control	
6.1 Weeds control on plantation material	
- Natural control	0
- Chemical substance usage	0
- Physical or mechanical removal	100
Total	100
6.2 Weeds control on ground	
- Natural control	0.00
- Chemical substance usage	77.78
- Physical or mechanical removal	22.22
Total	100.00

Table F-5 Knowledge and usage of EM for the orchid cultivation

The knowledge and usage about EM	Number
1) Never know EM	1
Know EM	71
Total	72
2) The first source of knowledge in EM	
Neighbour and member club	21
Government officer	
- Tambon agicultural officer	7
- District agicultural officer	23
- Agricultural Occupation Development and Promotion centre; Samutsakhon Province	3
Journal/Newspaper	0
Radio/Television	4
Others	13
Total	71
3) Access information in agriculture	
No	28
Yes	44
Total	72

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Table F-5 Knowledge and usage of EM for the orchid cultivation (Continued)

The knowledge and usage about EM	Number
4) Source of information	
Neighbour and member club	5
Government officer	36
Journal/Newspaper	0
Radio/Television	0
Others	3
Total	44
5) Used to use EM for orchid cultivation	
Use	42
Never use	30
Total	72
6) Use EM for orchid cultivation in the present and reasons	
Yes	
- EM help to increase products and no any health effects on agriculturists	3
- EM help to increase products and reduce operation cost	1
- No reasons to support	3
No	
- Unconvenience for usage	7
- No any increase product quality and quantity	8
- Cause defoliation and fungi infection and orchid leaves and stems	4
- Quickly deterioration of plantation material	16
Total	42

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APPENDIX G
RATING SCALE AND SCORE

Table G-1 Rating scale of each parameter

	parameter					
	The number of bloom flower per bunch	**The number of flower per bunch**	**The diameter of the biggest flower in the bunch**	**The number of orchid bunch**	**The number of new orchid bunch**	**The bunch length**
a	2.02	3.65	3.36	0.16	1.16	26.03
b	0.99	1.61	1.72	0.09	0.30	8.48
c	0.48	1.03	1.15	0.03	0.61	12.97
0 score	≤ 0.48	≤ 1.03	≤ 1.15	≤ 0.03	≤ 0.61	≤ 12.97
1 score	0.49–1.03	1.04–2.04	1.16–1.64	0.04–0.07	0.62–0.86	12.98–17.55
2 scores	1.04–2.02	2.05–3.65	1.65–3.36	0.08–0.16	0.87–1.16	17.56–26.03
3 scores	2.03–3.01	3.66–5.26	3.37–5.07	0.17–0.24	1.17–1.46	26.04–34.51
4 scores	> 3.01	> 5.26	> 5.07	> 0.24	> 1.46	> 34.51

Table G-2 The score of each treatment that get from the evaluation

treatment	**parameter**						**Total score**
	The number of bloom flower per bunch	**The number of flower per bunch**	**The diameter of the biggest flower in the bunch (cm.)**	**The number of orchid bunch**	**The number of new orchid bunch**	**The bunch length (cm.)**	
week 2							
1	3	2	3	0	0	2	10
2	3	3	3	1	0	2	12
3	4	3	4	1	3	2	17
4	4	3	4	1	2	2	16
5	3	2	3	0	2	2	12
6	2	2	3	0	0	2	9
7	2	2	2	1	4	1	12
8	3	3	3	2	0	3	14

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Table G-2 The score of each treatment that get from the evaluation (Cont.)

treatment	parameter						Total score
	The number of bloom flower per bunch	The number of flower per bunch	The diameter of the biggest flower in the bunch (cm.)	The number of orchid bunch	The number of new orchid bunch	The bunch length (cm.)	
week 4							
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	1	0	0	0	0	0	1
7	0	1	0	1	0	1	3
8	2	2	2	1	0	1	8
week 6							
1	0	0	0	0	0	1	1
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	1	0	2	0	0	3
6	0	0	0	0	3	0	3
7	1	2	1	2	0	2	8
8	2	2	2	2	0	1	9
week 8							
1	0	1	1	1	0	1	4
2	0	1	0	1	0	2	4
3	0	0	0	2	0	2	4
4	0	1	0	2	0	2	5
5	2	2	2	3	0	3	12
6	0	1	0	0	0	0	1
7	2	2	2	2	0	3	11
8	0	0	0	1	0	2	3
week 10							
1	1	1	2	0	3	0	7
2	2	2	2	2	3	2	13
3	1	1	1	2	0	3	8
4	2	3	2	1	4	3	15
5	2	2	2	2	3	3	14
6	0	0	0	0	0	0	0
7	2	2	1	1	0	3	9
8	2	2	2	1	2	2	11
week 12							
1	0	0	0	0	0	1	1
2	2	2	2	1	0	2	9
3	3	4	4	2	0	4	17
4	3	3	3	2	0	3	14
5	3	4	4	2	0	3	16
6	1	1	2	1	0	1	6
7	2	2	2	1	0	2	9
8	4	3	4	2	0	3	16

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Table G-2 The score of each treatment that get from the evaluation (Cont.)

treatment	parameter						Total score
	The number of bloom flower per bunch	The number of flower per bunch	The diameter of the biggest flower in the bunch (cm.)	The number of orchid bunch	The number of new orchid bunch	The bunch length (cm.)	
week 14							
1	0	0	0	1	0	0	1
2	0	1	1	2	2	2	8
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	2	1	2	1	0	2	8
6	0	0	0	3	3	2	8
7	0	0	0	1	0	2	3
8	0	0	0	2	0	2	4
week 16							
1	0	0	0	2	0	1	3
2	0	0	1	3	0	2	6
3	0	0	0	0	2	0	2
4	1	0	1	2	2	1	7
5	2	2	2	2	2	2	12
6	1	1	2	4	0	2	10
7	0	0	1	1	0	2	4
8	2	2	2	1	0	2	9

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APPENDIX H

DATA OF EM EFFICIENCY

Table H-1 Data of EM efficiency

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
		2nd week (observed at 8 July 2005)					
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	4.00	5.00	8.50	1.00	0.00	35.00
	4	5.00	6.00	9.00	1.00	0.00	31.00
	5	0.00	0.00	0.00	1.00	0.00	33.00
	6	2.00	2.00	8.00	1.00	0.00	22.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	5.00	5.00	8.00	1.00	0.00	25.00
	9	5.00	9.00	7.50	1.00	0.00	39.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	2.10	2.70	4.10	0.60	0.00	18.50
	S.D.	2.38	3.30	4.34	0.52	0.00	16.61
2	1	6.00	7.00	8.00	1.00	0.00	29.00
	2	2.00	8.00	8.00	1.00	0.00	36.00
	3	5.00	5.00	8.50	1.00	0.00	33.00
	4	5.00	5.00	7.50	1.00	0.00	23.00
	5	4.00	6.00	7.00	1.00	0.00	28.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	26.00
	8	0.00	2.00	0.00	1.00	0.00	12.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	4.00	0.00	1.00	0.00	25.50
	Mean	2.20	3.70	3.90	0.80	0.00	21.25
	S.D.	2.53	3.02	4.13	0.42	0.00	12.88
3	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	5.00	7.00	8.00	1.00	0.00	29.00
	3	6.00	7.00	9.00	1.00	0.00	38.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	5.00	6.00	7.50	1.00	1.00	27.50
	6	1.00	4.00	8.50	1.00	0.00	24.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	5.00	6.00	7.50	1.00	0.00	31.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
3	9	8.00	9.00	7.00	1.00	1.00	43.00
	10	6.00	7.00	7.00	1.00	0.00	30.00
	Mean	3.60	4.60	5.45	0.70	0.20	22.25
	S.D.	3.03	3.41	3.81	0.48	0.42	16.25
4	1	4.00	8.00	8.50	1.00	0.00	38.00
	2	5.00	8.00	8.50	1.00	0.00	39.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	5.00	5.00	8.00	1.00	0.00	28.00
	5	3.00	4.00	8.00	1.00	0.00	28.00
	6	3.00	5.00	8.00	1.00	0.00	29.00
	7	4.00	6.00	8.00	1.00	0.00	33.00
	8	7.00	8.00	7.50	1.00	1.00	39.50
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	3.10	4.40	5.65	0.70	0.10	23.45
	S.D.	2.42	3.34	3.91	0.48	0.32	16.75
5	1	ND	ND	ND	1.00	0.00	ND
	2	ND	ND	ND	1.00	0.00	ND
	3	8.00	10.00	8.50	1.00	1.00	41.50
	4	5.00	6.00	7.00	1.00	0.00	30.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	5.00	7.00	8.00	1.00	0.00	34.50
	9	4.00	5.00	8.00	1.00	0.00	35.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	2.75	3.50	3.94	0.60	0.10	17.63
	S.D.	3.15	4.00	4.23	0.52	0.32	19.10
6	1	0.00	0.00	0.00	1.00	0.00	43.50
	2	5.00	6.00	8.50	1.00	0.00	35.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	4.00	9.00	8.50	1.00	0.00	45.00
	6	3.00	9.00	7.50	1.00	0.00	39.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	5.00	5.00	8.00	1.00	0.00	30.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	D	D	D	D	D	D
	Mean	1.89	3.22	3.61	0.56	0.00	21.39
	S.D.	2.32	4.02	4.29	0.53	0.00	20.75
7	1	0.00	0.00	0.00	1.00	0.00	26.00
	2	0.00	0.00	0.00	0.00	0.00	0.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
7	3	0.00	0.00	0.00	1.00	0.00	0.50
	4	0.00	0.00	0.00	1.00	0.00	0.50
	5	0.00	0.00	0.00	1.00	0.00	0.50
	6	3.00	5.00	7.50	1.00	0.00	28.00
	7	5.00	5.00	7.50	1.00	1.00	18.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	7.00	7.00	8.00	1.00	1.00	31.50
	10	2.00	6.00	7.50	1.00	1.00	30.00
	Mean	1.70	2.30	3.05	0.80	0.30	13.50
	S.D.	2.54	3.02	3.94	0.42	0.48	14.35
8	1	6.00	6.00	8.00	1.00	0.00	30.00
	2	0.00	0.00	0.00	1.00	0.00	28.00
	3	0.00	0.00	0.00	2.00	0.00	28.00
	4	7.00	10.00	8.00	1.00	0.00	42.00
	5	3.00	8.00	8.00	1.00	0.00	39.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	5.00	7.00	7.50	1.00	0.00	33.50
	8	1.00	8.00	7.50	1.00	0.00	35.50
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	2.75	4.88	4.88	1.00	0.00	29.50
	S.D.	2.92	4.19	4.04	0.53	0.00	12.95
4th week (observed at 22 July 2005)							
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	9.00
	3	0.00	0.00	0.00	1.00	0.00	1.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	2.00	4.00	7.00	1.00	0.00	37.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	2.00	0.00	13.50
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.20	0.40	0.70	0.50	0.00	6.05
	S.D.	0.63	1.26	2.21	0.71	0.00	11.87
2	1	0.00	0.00	0.00	1.00	0.00	7.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	6.00	0.00	1.00	0.00	31.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	8.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
2	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.60	0.00	0.30	0.00	4.60
	S.D.	0.00	1.90	0.00	0.48	0.00	9.79
3	1	0.00	0.00	0.00	1.00	0.00	9.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	1.00	0.00	1.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	1.00	0.00	1.00
	Mean	0.00	0.00	0.00	0.30	0.00	1.10
	S.D.	0.00	0.00	0.00	0.48	0.00	2.81
4	1	0.00	0.00	0.00	1.00	0.00	1.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	0.50
	10	0.00	0.00	0.00	1.00	0.00	1.00
	Mean	0.00	0.00	0.00	0.30	0.00	0.25
	S.D.	0.00	0.00	0.00	0.48	0.00	0.42
5	1	0.00	0.00	0.00	1.00	0.00	0.50
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	1.00	0.00	22.00
	7	0.00	0.00	0.00	2.00	0.00	12.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	1.00	0.00	17.00
	Mean	0.00	0.00	0.00	0.50	0.00	5.15
	S.D.	0.00	0.00	0.00	0.71	0.00	8.51
6	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
6	6	8.00	9.00	8.00	1.00	0.00	34.00
	7	0.00	0.00	0.00	1.00	0.00	16.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	D	D	D	D	D	D
	Mean	0.89	1.00	0.89	0.22	0.00	5.56
	S.D.	2.67	3.00	2.67	0.44	0.00	11.91
7	1	0.00	5.00	0.00	1.00	0.00	30.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	2.00	0.00	18.50
	4	0.00	0.00	0.00	1.00	0.00	26.00
	5	0.00	6.00	0.00	1.00	0.00	30.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	1.00	0.00	31.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	1.00	0.00	1.00
	Mean	0.00	1.10	0.00	0.70	0.00	13.65
	S.D.	0.00	2.33	0.00	0.67	0.00	14.59
8	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	6.33	0.00	3.00	0.00	34.50
	3	0.00	0.00	0.00	1.00	0.00	9.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	7.00	8.00	8.00	1.00	0.00	40.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	5.00	9.00	9.00	1.00	0.00	42.00
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	1.50	2.92	2.13	0.75	0.00	15.69
	S.D.	2.83	4.09	3.94	1.04	0.00	19.52
6th week (observed at 5 August 2005)							
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	32.00
	3	0.00	0.00	0.00	1.00	0.00	21.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	3.00	0.00	1.00	0.00	30.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	5.00	0.00	1.00	0.00	32.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	19.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.80	0.00	0.50	0.00	13.40
	S.D.	0.00	1.75	0.00	0.53	0.00	14.74

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
2	1	0.00	0.00	0.00	1.00	0.00	32.00
	2	0.00	0.00	0.00	1.00	0.00	5.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	1.00	0.00	23.50
	5	0.00	0.00	0.00	1.00	0.00	2.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	15.25
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.50	0.00	7.78
	S.D.	0.00	0.00	0.00	0.53	0.00	11.71
3	1	0.00	5.00	0.00	1.00	0.00	29.00
	2	0.00	0.00	0.00	1.00	0.00	1.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	2.00	0.00	11.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	1.00	0.00	26.50
	Mean	0.00	0.50	0.00	0.50	0.00	6.75
	S.D.	0.00	1.58	0.00	0.71	0.00	11.59
4	1	0.00	0.00	0.00	1.00	0.00	26.00
	2	0.00	0.00	0.00	1.00	0.00	13.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	1.00	0.00	10.00
	7	0.00	0.00	0.00	1.00	0.00	20.50
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	21.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.50	0.00	9.05
	S.D.	0.00	0.00	0.00	0.53	0.00	10.47
5	1	0.00	0.00	0.00	1.00	0.00	13.50
	2	0.00	0.00	0.00	1.00	0.00	2.00
	3	0.00	0.00	0.00	1.00	0.00	2.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	7.00	0.00	1.00	0.00	35.00
	7	0.00	6.00	0.00	2.00	0.00	35.00
	8	0.00	0.00	0.00	1.00	0.00	9.50

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
5	9	0.00	0.00	0.00	1.00	0.00	2.00
	10	0.00	5.00	0.00	1.00	0.00	26.00
	Mean	0.00	1.80	0.00	0.90	0.00	12.50
	S.D.	0.00	2.94	0.00	0.57	0.00	14.33
6	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	1.00	0.00	6.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	5.00	0.00	1.00	0.00	33.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	D	D	D	D	D	D
	Mean	0.00	0.56	0.00	0.00	0.22	4.33
	S.D.	0.00	1.67	0.00	0.44	0.00	10.93
7	1	4.00	5.00	8.00	1.00	0.00	27.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	5.50	0.00	2.00	0.00	32.50
	4	0.00	10.00	0.00	1.00	0.00	40.00
	5	5.00	6.00	7.50	1.00	0.00	30.00
	6	0.00	0.00	0.00	1.00	0.00	6.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	8.00	0.00	1.00	0.00	40.00
	9	0.00	0.00	0.00	1.00	0.00	6.00
	10	0.00	0.00	0.00	1.00	0.00	9.50
	Mean	0.90	3.45	1.55	0.90	0.00	19.10
	S.D.	1.91	3.89	3.27	0.57	0.00	16.33
8	1	0.00	0.00	0.00	1.00	0.00	19.00
	2	7.00	10.00	11.75	3.00	0.00	32.67
	3	0.00	0.00	0.00	1.00	0.00	30.00
	4	0.00	0.00	0.00	1.00	0.00	8.00
	5	0.00	0.00	0.00	1.00	0.00	1.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	2.00
	8	8.00	9.00	8.50	1.00	0.00	37.50
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	1.88	2.38	2.53	1.13	0.00	16.27
	S.D.	3.48	4.41	4.77	0.83	0.00	15.52
8th week (observed at 19 August 2005)							
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	1.00	8.00	8.00	1.00	0.00	41.50
	3	0.00	0.00	0.00	2.00	0.00	30.50

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
1	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	2.00	7.00	7.75	2.00	0.00	37.75
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	2.00	0.00	25.75
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.30	1.50	1.58	0.70	0.00	13.55
	S.D.	0.67	3.17	3.32	0.95	0.00	17.96
2	1	0.00	8.00	0.00	1.00	0.00	43.00
	2	0.00	0.00	0.00	1.00	0.00	33.00
	3	0.00	0.00	0.00	1.00	0.00	0.50
	4	0.00	0.00	0.00	1.00	0.00	39.00
	5	0.00	0.00	0.00	1.00	0.00	27.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	1.00	3.50	3.75	2.00	0.00	33.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.10	1.15	0.38	0.70	0.00	17.60
	S.D.	0.32	2.65	1.19	0.67	0.00	18.88
3	1	1.00	6.00	7.50	1.00	0.00	36.50
	2	0.00	0.00	0.00	1.00	0.00	24.50
	3	0.00	0.00	0.00	1.00	0.00	33.50
	4	0.00	0.00	0.00	1.00	0.00	11.00
	5	0.00	0.00	0.00	1.00	0.00	10.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	10.50
	8	0.00	0.00	0.00	1.00	0.00	31.00
	9	0.00	0.00	0.00	1.00	0.00	19.50
	10	0.00	0.00	0.00	1.00	0.00	38.00
	Mean	0.10	0.60	0.75	0.90	0.00	21.50
	S.D.	0.32	1.90	2.37	0.32	0.00	13.16
4	1	0.00	0.00	0.00	2.00	0.00	33.50
	2	0.00	0.00	0.00	2.00	0.00	30.50
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	2.00	0.00	22.75
	7	0.00	7.00	0.00	1.00	0.00	42.00
	8	0.00	0.00	0.00	1.00	0.00	19.00
	9	0.00	8.00	0.00	1.00	0.00	38.50
	10	0.00	0.00	0.00	0.00	0.00	0.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
4	Mean	0.00	1.50	0.00	0.90	0.00	18.63
	S.D.	0.00	3.17	0.00	0.88	0.00	17.35
5	1	0.00	7.00	0.00	1.00	0.00	41.00
	2	0.00	0.00	0.00	1.00	0.00	22.50
	3	0.00	0.00	0.00	1.00	0.00	27.00
	4	0.00	0.00	0.00	1.00	0.00	10.50
	5	0.00	0.00	0.00	1.00	0.00	21.00
	6	4.00	9.00	8.50	1.00	0.00	41.50
	7	2.50	7.00	7.75	2.00	0.00	43.25
	8	0.00	0.00	0.00	2.00	0.00	21.00
	9	0.00	0.00	0.00	2.00	0.00	18.75
	10	4.00	5.00	7.50	1.00	0.00	31.00
	Mean	1.05	2.80	2.38	1.30	0.00	27.75
	S.D.	1.74	3.74	3.83	0.48	0.00	11.12
6	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	21.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	2.00	0.00	34.75
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	3.00	10.00	8.00	1.00	0.00	44.50
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	D	D	D	D	D	D
	Mean	0.33	1.11	0.89	0.44	0.00	11.14
	S.D.	1.00	3.33	2.67	0.73	0.00	17.72
7	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	28.50
	3	3.50	6.50	7.50	2.00	0.00	36.00
	4	6.00	11.00	8.50	1.00	0.00	46.50
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	1.00	0.00	33.50
	7	0.00	0.00	0.00	1.00	0.00	29.50
	8	6.00	8.00	8.00	1.00	0.00	43.00
	9	0.00	0.00	0.00	1.00	0.00	32.50
	10	0.00	0.00	0.00	1.00	0.00	35.00
	Mean	1.55	2.55	2.40	0.90	0.00	28.45
	S.D.	2.59	4.25	3.87	0.57	0.00	15.98
8	1	0.00	0.00	0.00	2.00	0.00	28.25
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	1.00	6.00	8.00	1.00	0.00	38.00
	4	0.00	0.00	0.00	1.00	0.00	31.00
	5	0.00	0.00	0.00	1.00	0.00	24.50
	6	0.00	0.00	0.00	0.00	0.00	0.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
8	7	0.00	0.00	0.00	1.00	0.00	25.50
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	0.13	0.75	1.00	0.75	0.00	18.41
	S.D.	0.35	2.12	2.83	0.71	0.00	15.78
10th week (observed at 2 September 2005)							
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	4.00	10.00	9.00	1.00	1.00	48.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	4.00	8.00	8.00	1.00	1.00	47.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.80	1.80	1.70	0.20	0.20	9.50
	S.D.	1.69	3.82	3.59	0.42	0.42	20.03
2	1	5.00	9.00	9.00	1.00	1.00	33.00
	2	0.00	0.00	0.00	1.00	0.00	42.00
	3	0.00	0.00	0.00	3.00	0.00	8.83
	4	4.00	8.00	8.00	1.00	0.00	44.00
	5	0.00	0.00	0.00	1.00	0.00	39.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	15.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	5.00	8.00	7.50	1.00	1.00	41.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	1.40	2.50	2.45	0.90	0.20	22.33
	S.D.	2.27	4.03	3.96	0.88	0.42	19.28
3	1	5.00	6.00	8.50	1.00	0.00	33.00
	2	0.00	0.00	0.00	1.00	0.00	43.00
	3	0.00	0.00	0.00	1.00	0.00	48.00
	4	0.00	0.00	0.00	1.00	0.00	34.50
	5	0.00	0.00	0.00	1.00	0.00	30.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	32.00
	8	0.00	0.00	0.00	1.00	0.00	40.50
	9	0.00	0.00	0.00	1.00	0.00	32.00
	10	5.00	8.00	7.50	1.00	0.00	41.50
	Mean	1.00	1.40	1.60	0.90	0.00	33.45
	S.D.	2.11	2.99	3.38	0.32	0.00	13.14

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
4	1	5.00	9.00	8.50	1.00	1.00	45.50
	2	2.00	9.00	7.50	1.00	1.00	44.50
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	1.00	0.00	1.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	9.00	0.00	1.00	2.00	45.50
	7	4.00	11.00	8.00	1.00	0.00	50.00
	8	0.00	0.00	0.00	1.00	0.00	38.52
	9	3.00	6.00	8.00	1.00	0.00	41.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	1.40	4.40	3.20	0.70	0.40	26.60
	S.D.	1.96	4.79	4.14	0.48	0.70	22.88
5	1	4.00	8.00	8.50	1.00	0.00	36.50
	2	0.00	0.00	0.00	1.00	0.00	34.00
	3	0.00	0.00	0.00	1.00	0.00	44.00
	4	0.00	0.00	0.00	1.00	0.00	28.00
	5	0.00	0.00	0.00	1.00	0.00	35.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	6.00	6.00	8.00	1.00	0.00	43.50
	8	2.00	8.00	6.50	1.00	1.00	37.50
	9	0.00	0.00	0.00	1.00	1.00	40.50
	10	5.00	5.00	7.00	1.00	0.00	26.50
	Mean	1.70	2.70	3.00	0.90	0.20	32.60
	S.D.	2.41	3.59	3.91	0.32	0.42	12.83
6	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	31.50
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	2.00	0.00	47.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	1.00	0.00	37.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	D	D	D	D	D	D
	Mean	0.00	0.00	0.00	0.44	0.00	12.83
	S.D.	0.00	0.00	0.00	0.73	0.00	19.65
7	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	39.50
	3	5.00	5.00	7.00	1.00	0.00	26.50
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	9.00	0.00	1.00	0.00	44.50
	7	0.00	0.00	0.00	1.00	0.00	39.00
	8	7.00	7.00	7.50	1.00	0.00	39.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
7	9	0.00	0.00	0.00	1.00	0.00	45.00
	10	0.00	10.00	0.00	1.00	0.00	44.00
	Mean	1.20	3.10	1.45	0.70	0.00	27.75
	S.D.	2.57	4.20	3.06	0.48	0.00	19.85
8	1	3.00	8.00	8.00	1.00	1.00	42.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	5.00	6.00	8.00	1.00	0.00	36.00
	4	1.00	7.00	7.50	1.00	0.00	37.50
	5	0.00	0.00	0.00	1.00	0.00	42.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	41.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	1.13	2.63	2.94	0.63	0.13	24.81
	S.D.	1.89	3.66	4.06	0.52	0.35	20.65
12nd week (observed at 16 September 2005)							
1	1	0.00	0.00	0.00	1.00	0.00	15.50
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	3.00	8.00	7.50	1.00	0.00	41.00
	4	0.00	0.00	0.00	2.00	0.00	20.25
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	1.00	0.00	18.00
	9	0.00	0.00	0.00	1.00	0.00	37.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.30	0.80	0.75	0.60	0.00	13.18
	S.D.	0.95	2.53	2.37	0.70	0.00	15.95
2	1	7.00	7.00	8.50	1.00	0.00	34.00
	2	3.00	7.00	8.00	1.00	0.00	47.50
	3	0.00	0.00	0.00	3.00	0.00	24.33
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	4.00	9.00	8.00	1.00	0.00	34.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	37.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	30.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	1.40	2.30	2.45	0.80	0.00	20.68
	S.D.	2.46	3.74	3.95	0.92	0.00	18.71
3	1	4.00	4.00	8.50	1.00	0.00	32.00
	2	4.00	10.00	8.50	1.00	0.00	47.50
	3	5.00	10.00	8.50	1.00	0.00	42.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
3	4	0.00	8.00	0.00	1.00	0.00	40.50
	5	1.00	6.00	6.00	1.00	0.00	35.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	6.00	0.00	1.00	0.00	36.00
	8	2.00	7.00	7.50	1.00	0.00	41.50
	9	3.00	6.00	7.50	1.00	0.00	36.50
	10	7.00	7.00	7.00	1.00	0.00	37.50
	Mean	2.60	6.40	5.35	0.90	0.00	34.85
	S.D.	2.41	2.91	3.77	0.32	0.00	13.00
4	1	4.00	7.00	8.50	1.00	0.00	38.50
	2	4.00	8.00	8.50	1.00	0.00	43.00
	3	0.00	0.00	0.00	3.00	0.00	13.33
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	4.00	6.50	7.75	2.00	0.00	41.00
	7	6.00	10.00	8.50	1.00	0.00	55.00
	8	2.00	9.00	8.00	1.00	0.00	46.00
	9	6.00	6.00	8.00	1.00	0.00	36.50
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	2.60	4.65	4.93	1.00	0.00	27.33
	S.D.	2.50	4.16	4.25	0.94	0.00	21.58
5	1	4.00	5.00	8.50	1.00	0.00	39.50
	2	1.00	7.00	8.00	1.00	0.00	40.00
	3	5.00	10.00	8.50	1.00	0.00	49.00
	4	0.00	6.00	0.00	1.00	0.00	33.00
	5	3.00	7.00	8.00	1.00	0.00	33.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	4.00	4.00	8.00	1.00	0.00	36.00
	8	0.00	5.00	0.00	1.00	0.00	27.00
	9	1.50	6.50	4.00	2.00	0.00	39.50
	10	3.00	4.00	8.00	1.00	0.00	27.00
	Mean	2.15	5.45	5.30	1.00	0.00	32.45
	S.D.	1.89	2.61	3.88	0.47	0.00	13.15
6	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	4.00	7.00	8.00	1.00	0.00	39.00
	3	0.00	0.00	0.00	1.00	0.00	5.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	2.50	5.50	7.25	2.00	0.00	50.50
	6	0.00	0.00	0.00	1.00	0.00	12.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	28.00
	10	D	D	D	D	D	D

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
6	Mean	0.72	1.39	1.69	0.67	0.00	14.94
	S.D.	1.48	2.78	3.37	0.71	0.00	19.41
7	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	30.50
	3	4.00	4.00	7.00	1.00	0.00	27.50
	4	ND	ND	ND	ND	ND	ND
	5	0.00	0.00	0.00	1.00	0.00	11.50
	6	0.00	0.00	0.00	1.00	0.00	6.00
	7	4.00	9.00	7.50	1.00	0.00	46.00
	8	ND	ND	ND	ND	ND	ND
	9	6.00	10.00	8.50	1.00	0.00	49.50
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	1.75	2.88	2.88	0.75	0.00	21.38
	S.D.	2.49	4.32	3.99	0.46	0.00	19.88
8	1	7.00	7.00	7.50	1.00	0.00	39.00
	2	0.00	0.00	0.00	1.00	0.00	31.00
	3	5.00	5.00	8.00	1.00	0.00	35.00
	4	5.00	8.00	9.00	1.00	0.00	38.00
	5	4.00	9.00	8.50	1.00	0.00	35.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	4.00	11.00	8.00	1.00	0.00	46.00
	8	0.00	0.00	0.00	1.00	0.00	29.00
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	3.13	5.00	5.13	0.88	0.00	31.69
	S.D.	2.75	4.47	4.27	0.35	0.00	13.81
14th week (observed at 30 September 2005)							
1	1	0.00	0.00	0.00	2.00	0.00	31.00
	2	0.00	0.00	0.00	1.00	0.00	0.50
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	2.00	0.00	24.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	25.00
	8	0.00	0.00	0.00	1.00	0.00	27.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	1.00	0.00	20.00
	Mean	0.00	0.00	0.00	0.80	0.00	12.75
	S.D.	0.00	0.00	0.00	0.79	0.00	13.60
2	1	0.00	0.00	0.00	1.00	0.00	39.50
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	2.00	8.00	8.00	3.00	0.00	29.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
2	6	0.00	0.00	0.00	1.00	0.00	11.00
	7	2.00	8.00	8.00	1.00	0.00	44.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	42.50
	10	0.00	0.00	0.00	2.00	1.00	10.25
	Mean	0.40	1.60	1.60	0.90	0.10	17.63
	S.D.	0.84	3.37	3.37	0.99	0.32	19.04
3	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	1.00	6.00	7.00	1.00	0.00	36.00
	6	0.00	0.00	0.00	1.00	0.00	9.00
	7	0.00	0.00	0.00	1.00	0.00	7.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.10	0.60	0.70	0.30	0.00	5.20
	S.D.	0.32	1.90	2.21	0.48	0.00	11.33
4	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	3.00	0.00	28.50
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	4.00	4.00	8.00	2.00	0.00	26.75
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.40	0.40	0.80	0.50	0.00	5.53
	S.D.	1.26	1.26	2.53	1.08	0.00	11.66
5	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	3.00	4.00	8.00	1.00	0.00	36.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	4.00	6.00	7.50	1.00	0.00	30.00
	5	0.00	0.00	0.00	1.00	0.00	40.00
	6	0.00	0.00	0.00	1.00	0.00	31.50
	7	0.00	0.00	0.00	1.00	0.00	9.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	6.00	6.00	7.75	2.00	0.00	35.25
	10	0.00	0.00	0.00	1.00	0.00	20.00
	Mean	1.30	1.60	2.33	0.80	0.00	20.18
	S.D.	2.21	2.63	3.75	0.63	0.00	16.47

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
6	1	0.00	0.00	0.00	1.00	1.00	17.50
	2	0.00	0.00	0.00	1.00	0.00	36.50
	3	0.00	0.00	0.00	2.00	0.00	18.75
	4	0.00	0.00	0.00	2.00	0.00	12.75
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	3.00	0.00	20.33
	7	0.00	0.00	0.00	1.00	1.00	21.00
	8	0.00	0.00	0.00	2.00	0.00	22.50
	9	0.00	0.00	0.00	1.00	0.00	35.50
	10	D	D	D	D	D	D
	Mean	0.00	0.00	0.00	1.44	0.22	20.54
	S.D.	0.00	0.00	0.00	0.88	0.44	11.05
7	1	0.00	0.00	0.00	1.00	0.00	15.00
	2	0.00	0.00	0.00	1.00	0.00	42.00
	3	0.00	0.00	0.00	2.00	0.00	17.00
	4	0.00	0.00	0.00	1.00	0.00	37.00
	5	0.00	0.00	0.00	1.00	0.00	29.50
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	1.00	0.00	33.50
	9	0.00	0.00	0.00	1.00	0.00	23.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.80	0.00	19.70
	S.D.	0.00	0.00	0.00	0.63	0.00	15.94
8	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	2.00	0.00	35.50
	3	0.00	0.00	0.00	1.00	0.00	36.50
	4	0.00	0.00	0.00	2.00	0.00	32.25
	5	0.00	0.00	0.00	1.00	0.00	27.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	1.00	0.00	39.00
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D
	Mean	0.00	0.00	0.00	0.88	0.00	21.28
	S.D.	0.00	0.00	0.00	0.83	0.00	17.97
16th week (observed at 14 October 2005)							
1	1	0.00	0.00	0.00	1.00	0.00	32.50
	2	0.00	0.00	0.00	1.00	0.00	12.00
	3	0.00	0.00	0.00	1.00	0.00	1.00
	4	0.00	0.00	0.00	3.00	0.00	23.67
	5	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	41.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
1	8	1.00	2.50	4.00	2.00	0.00	19.75
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	1.00	0.00	38.50
	Mean	0.10	0.25	0.40	1.00	0.00	16.84
	S.D.	0.32	0.79	1.26	0.94	0.00	16.59
2	1	2.00	5.00	9.00	1.00	0.00	44.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	3.00	0.00	27.33
	4	0.00	0.00	0.00	1.00	0.00	27.00
	5	0.00	0.00	0.00	1.00	0.00	27.00
	6	0.00	0.00	0.00	2.00	0.00	30.75
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	1.00	0.00	1.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.33	1.00	2.67	3.00	0.00	22.33
	Mean	0.23	0.60	1.17	1.20	0.00	17.94
	S.D.	0.63	1.58	2.88	1.14	0.00	16.22
3	1	0.00	0.00	0.00	1.00	0.00	20.50
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	2.00	0.00	22.25
	6	0.00	0.00	0.00	1.00	1.00	35.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	1.00	0.00	1.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.00	0.00	0.00	0.50	0.10	7.88
	S.D.	0.00	0.00	0.00	0.71	0.32	13.00
4	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	1.00
	3	3.00	5.00	7.50	2.00	0.00	30.00
	4	0.00	0.00	0.00	1.00	1.00	28.00
	5	0.00	0.00	0.00	1.00	0.00	27.00
	6	2.50	2.50	8.25	2.00	0.00	27.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	2.00	0.00	9.25
	10	0.00	0.00	0.00	1.00	0.00	20.50
	Mean	0.55	0.75	1.58	1.00	0.10	14.28
	S.D.	1.17	1.69	3.33	0.82	0.32	13.38
5	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	3.00	3.00	8.00	1.00	1.00	36.50
	3	0.00	0.00	0.00	1.00	0.00	1.00

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
5	4	3.00	3.00	7.50	1.00	0.00	29.00
	5	4.00	11.00	8.50	1.00	0.00	48.00
	6	0.00	0.00	0.00	1.00	0.00	41.50
	7	0.00	0.00	0.00	2.00	0.00	30.50
	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	5.00	5.00	8.00	2.00	0.00	35.00
	10	0.00	0.00	0.00	1.00	0.00	24.50
	Mean	1.50	2.20	3.20	1.00	0.10	24.60
	S.D.	2.01	3.58	4.14	0.67	0.32	17.96
6	1	0.00	0.00	0.00	2.00	0.00	26.50
	2	4.00	11.00	9.00	1.00	0.00	45.50
	3	0.00	0.00	0.00	2.00	0.00	30.00
	4	0.00	0.00	0.00	2.00	0.00	30.50
	5	0.00	0.00	0.00	1.00	0.00	15.50
	6	0.33	2.33	2.50	3.00	0.00	31.00
	7	0.00	0.00	0.00	3.00	0.00	26.67
	8	0.00	0.00	0.00	1.00	0.00	5.00
	9	3.00	4.00	8.00	1.00	0.00	22.50
	10	D	D	D	D	D	D
	Mean	0.81	1.93	2.17	1.78	0.00	25.91
	S.D.	1.55	3.69	3.69	0.83	0.00	11.21
7	1	0.00	0.00	0.00	1.00	0.00	34.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	2.00	0.00	36.25
	4	0.00	0.00	0.00	1.00	0.00	47.00
	5	0.00	0.00	0.00	1.00	0.00	40.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.50	5.00	4.00	2.00	0.00	35.25
	9	2.00	2.00	9.00	1.00	0.00	17.00
	10	0.00	0.00	0.00	0.00	0.00	0.00
	Mean	0.25	0.70	1.30	0.80	0.00	20.95
	S.D.	0.63	1.64	2.98	0.79	0.00	19.50
8	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	1.00	0.00	34.50
	3	3.00	8.00	9.00	1.00	0.00	33.50
	4	3.00	10.00	8.50	1.00	0.00	46.50
	5	4.00	4.00	8.50	1.00	0.00	24.00
	6	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	1.00	0.00	1.00
	8	0.00	0.00	0.00	1.00	0.00	21.00
	9	D	D	D	D	D	D
	10	D	D	D	D	D	D

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Table H-1 Data of EM efficiency (Cont.)

Treatment	Pot No.	Parameter					
		Number of bloom flower per bunch	Number of flower per bunch	Diameter of the biggest flower in the bunch (cm.)	Number of orchid bunch	Number of new orchid bunch	Bunch length (cm.)
8	Mean	1.25	2.75	3.25	0.75	0.00	20.06
	S.D.	1.75	4.13	4.49	0.46	0.00	18.02

D: Death

ND: Not determine

S.D.: Standard deviation

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BIOGRAPHY

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